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New York

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E. L. Woodward
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Editorial Contents for December, 1929

Volume 103 *No. 12*

North Western Mechanical Forces Stabilized ..... **Page 712**

The Chicago & North Western inaugurated a system of budgeting monthly shop expenses, about four years ago, which has gradually been extended to all departments. This article describes the improvements in the operation of the motive-power department that have been secured since 1922.

How the Atlantic Coast Line Repairs Locomotives at Tampa . **Page 726**

This is the first installment of an article describing the operation and administration of the locomotive back shops of the Atlantic Coast Line at Tampa, Fla. This shop is considered to be one of the most modern back shops in the South.

Pullman Builds Modern Freight Shops at Bessemer, Ala. ..... **Page 743**

These shops were recently built for the manufacture of all types of steel and wood cars. They have a capacity of 25 cars per day. Included in this article is a list of the machine tools and shop equipment that have been installed.

EDITORIALS:

- Order Your 1929 Index 709
- Large Tender Tanks 709
- Relation of the Railways to Research 710
- The Next Job 710
- Stabilized Forces 711

GENERAL ARTICLES:

- North Western Mechanical Forces Stabilized 712
- 4-8-4 Type Locomotives for the Rock Island 717
- Shop-Made Chute for Sanding Locomotives .. 720
- Gages for Centering Wheels on Axles 721
- Arbitration Decisions 722
- Air Motor Adapted To a Special Job..... 723
- Valve-Seat Reamer for Booster 724
- Combination Gear and Bushing Puller 724
- Examples of Recent Passenger and Fast Freight Locomotives of the 4-8-2 Type 725
- How the Atlantic Coast Line Repairs Locomotives at Tampa 726
- Device for Wearing in Journal Bearings 735
- A Clamp for Handling Elesco Heater Tubes 736
- Rack for Drying Coach Curtains 736
- Air Brake Hose Coupling Gages 737
- A Kink for the Hostler 738
- Alloy Steels in Locomotive Construction 739
- Pullman Builds Modern Freight Shops at Bessemer, Ala. 743
- Present Day Demands of the Repair Track .. 748

READER'S PAGE:

- Interchange Inspectors Agents of A. R. A.? 751
- Maintenance of Draft Gears 751
- Comparing Costs—How Do You Figure Overhead? 752

NEW DEVICES:

- Electric Locomotive Mover 753
- Reclaiming Coil Springs 754
- Ace Heavy-Duty Electric Grinder 755
- Hascrome Welding Rod 755
- Triple-Valve Cylinder Truing Tool 756
- A One-Piece Nut with Grip Lock 756
- Simplex Swivel-Back Jaw Vise 757
- Buffalo 14-In. Hi-Speed Drills 757
- Micrometer Reads Ten-Thousandths Direct .. 758
- Buffing Wheel with Renewable Abrasive Strip 758

NEWS OF THE MONTH 759

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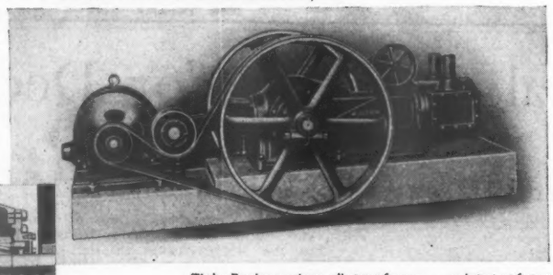

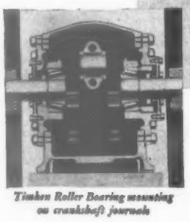

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Founded in 1832 as the American Rail-Road Journal

Vol. 103 December, 1929 No. 12

Order Your 1929 Index

TO any of our subscribers who would like to have a copy of the index for the 1929 issues of the *Railway Mechanical Engineer*, we shall be glad to send one. While much of the value of each issue is realized by the use which is made of it immediately after its publication, nevertheless numerous articles are published in the course of the year which it may be a great convenience to be able to locate readily after the particular issues in which they appeared have been forgotten. An index for each year's issues is carefully compiled according to subject matter, so that one need have little difficulty in locating any of the material appearing during the year. If you received last year's index, you will continue to receive succeeding issues without further attention. If you have not already asked to have your name placed on the list, do so without delay. You will then receive your copy of the 1929 index as soon as it is printed and will continue thereafter to receive each succeeding issue.

Large Tender Tanks

A DEVELOPMENT in locomotive equipment which has been taking place during the past four or five years and to which much less attention has been directed than its importance justifies is the increase in size and capacity of tender tanks. This development has been a factor in effecting the increased utilization of locomotives which has been so prominent a feature in the better operating practice effected during that period. It has been closely related to the wide-spread improvements in locomotive water supply which have been effected by water treatment and it has, therefore, played its part in the reduction of boiler maintenance resulting from better feedwater. It has facilitated the more intensive utilization of main-line tracks by the elimination of water and fuel stops and has played its part in eliminating the expenses which are directly caused by the stopping and starting of trains and in the reduction of crew overtime which the elimination of road delays has assisted in bringing about.

Ten years ago tanks with water and coal capacities of from 10,000 to 12,000 gallons and 16 to 18 tons, respectively, represented about the maximum which were being built. With the exception of the heavy 2-10-2 type and the 2-6-6-2 and 2-8-8-2 articulated locomotives, all of the locomotives built to the designs developed by the United States Railroad Administration were supplied with tenders having 10,000 gallons water capacity and 16 tons coal capacity, which weighed, loaded, about 97 tons. The heavy 2-10-2 type and the Mallet locomotives were supplied with tenders having 12,000 gallons water capacity and 16 tons coal capacity, which weighed, loaded, about 104 tons. During the past three years many tenders have been built for eight-coupled locomotives with water capacities of 15,000 to 16,000 gallons and coal capacities of 18 to 24 tons. These tenders have ranged in loaded weight from 141 tons to 155 tons. Tenders have been built for articulated locomotives and for some ten-coupled locomotives with water capacities of over 21,000 gallons and coal capacities of 24 tons or more. The loaded weight of such tenders runs well up to, and in some cases exceeds, 200 tons.

The larger tenders, with which new locomotives are now being supplied and which are being used to replace smaller tenders with which many existing locomotives were originally provided, represent increases in capacities ranging from 50 to nearly 90 per cent of the water and 50 per cent and more of the coal. The increases in the gross weight behind the locomotive drawbar run from about 60 to nearly 120 tons.

These increases in weight have, theoretically at least, reduced the possible train load from one to two cars. Actually, however, the increase in tender capacity has in some cases made possible an increase in train load where limited tank capacity makes full capacity working of the locomotive over certain sections of the line impossible without the risk of having to run for water. Under few conditions will any adverse effect upon train miles actually be felt, because there is seldom a day in which some condition or other does not require the operation of some trains with less than full tonnage. The theoretical increase in fuel consumption will scarcely amount to more than one or two per cent and, where intermediate water stops are eliminated, there will probably be an actual net saving in fuel, as well as in all of the other items which enter into the cost of stopping and starting heavy trains. The large tenders, by eliminating intermediate water stops, permit the full benefit of water treatment to be obtained by an investment in water-treating facilities at scarcely more than half of the water stations formerly required to supply feed-

water to locomotives served by the smaller tenders. Considering the importance of these advantages, the price which is being paid to secure them is a small one.

The Relation of the Railways to Research

IN an article dealing with the status of the use of alloy steels in railway equipment, which will be found elsewhere in this issue, Dr. William M. Barr, consulting chemist of the Union Pacific, concludes with a paragraph advocating joint railway research in this field. "There is so much still to be accomplished," he says, "that, with the railway laboratory forces burdened with so much routine work of such great variety, progress is necessarily slow. These problems with the many other material problems of the railroad demanding solution make it appear that the railways of the country could not do better than to pool their efforts and, following the example of a number of other large industrial organizations, establish a research laboratory in which such problems may be independently worked out unhampered by the daily operating cares that now infest the railway laboratories of the country."

The suggestion that the railroads, through the American Railway Association, develop a research organization and equip a research laboratory has been offered on numerous occasions in connection with a variety of specific problems of equipment design and operation. As a matter of fact the Mechanical Division of the American Railway Association has already undertaken extensive programs which, by a liberal interpretation of the term, may be characterized as research activities in two specific directions—air brakes and draft gears. Under a more strict definition of the term, however, these could scarcely be classified as research activities. They are more in the nature of comparative tests of specific draft gear and air brake equipment to determine their practicability and effectiveness to meet service conditions. The problem proposed by Dr. Barr in his article in this issue is one in which study of a strictly research character would produce useful results.

In considering proposals, the adoption of which implies the establishment of a research laboratory and staff organized to undertake a wide variety of research activities by the American Railway Association as the agent of all railroads, a number of fundamental conditions and relationships must be considered. First, the railroads are primarily operating organizations using equipment, devices and materials produced by a large number of manufacturing industries. Second, in other fields where analogous user and producer relationships obtain the user looks to the producer, with his specialized engineering and production knowledge, for the development of technical improvements in his product.

This may be illustrated by the automotive industry, the research activities of which have been cited in support of the proposal that the railroads undertake extensive research activities. In this case, however, the fact must not be overlooked that the research activities are conducted by the builders of automotive equipment rather than by the users of that equipment.

Third, the results of research activities can only be made valuable to the railroads by embodying them in the equipment, devices and materials which the railroads buy. There are probably few research problems, in the more strict definition of the term, the results of which would not be primarily of great commercial value to a few, and perhaps in some cases to all, of the manufacturers of products within the field covered.

It would, therefore, appear that in entering upon any broad program of research the railroads through the American Railway Association, would be in the position of financing the development of information which would be of most immediate commercial value to the producers of equipment, devices and materials, unless the research organization were to be so expanded as to be able to undertake the development of complete commercial applications, leaving the builders and producers no function but that of a contract manufacturer. The scope of such a program would obviously be enormous. Its centralized handling would scarcely be practicable and the ultimate results of doubtful value as compared with those now obtained by the operation of the initiative and talent of competing organizations seeking to build up commercially successful ventures.

These considerations suggest certain definite limitations for programs of joint research and testing undertaken by the railroads. The joint action of the railroads is most obviously necessary in dealing with problems where uniformity of operation is essential, such as is the case with the air brake, or where the conditions to be met are universally common as in the case of the draft gear. In neither of these cases, however, has the work of the association been of a strictly research character. Its purpose is to develop certain requisites which should be met by all producers of devices in the two fields. The solution of the problem of meeting these requisites is left to the ingenuity of the producers. In the case of the alloy steels to which Dr. Barr refers, may not the nature and scope of the research which may be necessary to produce satisfactory materials well be left to the decision of the metallurgical experts of the organizations interested in their development? May not the function of the user well be confined to the accumulation of experience data, which must come from the road and the shop, as well as from the laboratory? In making such data available to the manufacturers from as wide a range of sources as possible, have not the railroads served their interests in the most practicable and profitable manner?

The Next Job

BARRING accident damage it is not unreasonable to expect a modern locomotive to render 100,000 miles or more of efficient road service between shoppings for general repairs. In this intervening period many hours are spent in making running repairs at engine terminals and many dollars are likewise spent for replacement parts which have failed in service. The failure of a minor part of a locomotive is not in itself a serious matter but quite often it becomes necessary to remove and replace other parts which ordinarily might have remained in service until the next general shopping period. The average railroad has never developed to any elaborate extent what might be termed a "service research department" devoted to the analysis of the cause of minor failures, but it would seem that some work along this line might point the way to lower locomotive maintenance costs.

In days gone by, when modern alloy steels and heat-treating processes were unknown, when modern lubrication methods were as yet undeveloped and when machine tools of modern accuracy of finish were as yet

not thought of, it was necessary to build locomotives with rather liberal tolerances as far as the fitting of parts was concerned. Even now many railroads are still paying the price of obsolete materials and methods in a much higher cost of maintenance than is justified.

Other industries, notably the automotive industry, have pioneered the development of materials which possess long wearing and high fatigue-resisting qualities and, coincident with the fittings of parts to close tolerances, have developed to its present state the high-pressure oil and grease lubrication systems. The railroads as an industry have been extremely slow to take advantage of many things which obviously would result in the improvement of their own operation.

The average cost of locomotive repairs for American railroads, according to the latest available statistics, represents about 50 per cent of the total actual locomotive operating expenses, exclusive of the wages of enginemen. A large fleet operator of motor coaches and trucks reports the maintenance costs of his fleet at 16 per cent of total actual operating costs. A difference of 34 per cent. Why? To find out the answer is the next big job of our mechanical departments.

Stabilized Forces

MANY of the best informed railroad mechanical officers are coming to believe that further success in increasing the efficiency of their respective departments will depend largely on the ability of the railroads to control mechanical-department expenses so that a fairly uniform or stabilized force can be maintained throughout the year. It is obvious that the actual man-hours of productive labor must vary in direct proportion to the varying number of working days in each month and that the number will be affected by the number of men absent on account of vacations, sickness or other causes. It is equally true that local conditions may require transferring work and, consequently, men from one shop to another on the same railroad. That ways and means can be devised, however, to avoid drastic reductions and lay-offs of system forces and subsequent costly rebuilding of these forces to take care of deferred maintenance, has been conclusively demonstrated in the case of the Chicago & North Western, as described in an article in this issue.

Other roads, working along this line, have been measurably successful. It is believed, however, that none has exceeded the North Western which, under the present management, has maintained system motive power department forces within a maximum variation of 6,940 to 6,760 men during 1929; and most of this variation, which is only slightly over three per cent of the total force employed, was caused by the permanent closing of two small repair shops. As compared with a variation of over 25 per cent in 1921, for example, this represents a remarkable accomplishment.

The principal difficulty in the way of securing uniform mechanical-department operations and stabilized forces throughout the year, with many resultant advantages both to employees and the railroads, appears to be the variation in railroad traffic and earnings from month to month, but, while monthly revenues vary within wide limits, it has been found that the total income on an annual basis can be predicted with only a small percentage of error. It then becomes a question of general policy how the road will apportion its mechanical expenditures. What is borrowed from maintenance in months of small traffic must inevitably be paid back in months when traffic is heavy, and every experienced mechanical officer knows that the railroads pay heavily for "deferred" maintenance of this kind. Knowing within close limits the traffic to be handled, locomotive and car-miles to be run and general maintenance and running repair work required in 12 months, why not spread the appropriations for this work evenly throughout the year and thus get away from the expensive, morale-destroying practice of repeatedly laying off and building up mechanical forces? This is what the North Western has done.

No elaborate arguments are necessary to demonstrate the advantages of a practicable budget and force stabilization plan as applied to mechanical-department operations. In the first place, if maintenance work can be borrowed, it is never "for keeps." Mechanical forces, depleted in response to the demand to cut expenses, must be built up in a short time with the attendant loss of experienced men and almost as demoralizing an effect on the entire organization as when the reduction was made. Skilled, reliable men are not, in general, attracted to temporary positions, and the material available for building up new forces can not be of the best. It costs a definite amount, much larger than ordinarily appreciated, every time a new man is taken into railroad service and months usually elapse before new employees become accustomed to their new surroundings, new standards of work and the efficient handling thereof. This is all reflected in equipment-maintenance costs, reliability of equipment service, accidents on the road and personal injuries in shops and terminals.

While North Western mechanical forces in both the car and locomotive departments have been generally stabilized, the article mentioned refers in detail only to the motive-power department in which the generally higher standard of locomotive maintenance, made possible to a large extent by stabilization, is indicated by a substantial increase in power stored in good condition and a decrease from 19.3 to 11.8 per cent in power held out of service awaiting repairs. Good and thorough workmanship, practically impossible of attainment without a stabilized force, is also reflected in freedom from engine failures. The record of the North Western in this respect promises to be about 150,000 miles per failure in 1929. One of the most noticeable effects of the stabilization of forces is the reduction in personal injuries, this figure having been reduced to 11.76 injuries per million man-hours in 1929, which is especially creditable since, for the purpose of its own records, the North Western includes in this figure all injuries causing the loss of one day's time or more. The general efficiency of the motive power department and the way its work is scheduled and handled is reflected in the ratio of motive power expense to total railroad revenue and it is interesting to note that, on the North Western, this ratio has been decreased from 9.2 in 1923, to 6.82 in the first 9 months of 1929.

After all is said and done, the most important single advantage of stabilization of mechanical forces is in the ability it affords railroads to attract and hold a desirable class of employees who are skilled, careful workmen, willing to do a fair day's work for the company which provides them with steady employment. In other words, the plan not only helps the railroads to a more uniform and efficient operation, but greatly improves the conditions for workmen who are enabled to budget their own personal expenses and work without the constant fear that next week they may be looking for a job.

North Western Mechanical

Practical application of monthly budget and promotes improved working

Locomotive finishing shop, where train-control equipment is applied

ABOUT four years ago, a system of budgeting monthly expenses was inaugurated on the Chicago & North Western and gradually extended to all departments, including the mechanical department, where its practical application is commonly considered as difficult as it is desirable. It is now generally used in both the motive-power and car departments and has been instrumental in stabilizing shop forces throughout the year to an unusual extent, resulting in many economies to the railroad and advantages to the employees.

In the motive-power department for the first nine months of 1929, for example, the maximum variation of actual from estimated monthly budget expense, occurring in July, was only about 6.4 per cent; the labor budget was exceeded slightly in but two months and was under-run a maximum of only 5.3 per cent in July; monthly man-hours were held within the limits of 1,469,506 to 1,401,156; motive-power department employes varied in number from a maximum of 6,940 to a minimum of 6,760; the men benefited by steady work and the railroad profited by low labor turnover and the employment of a class of relatively better satisfied, more experienced, skillful and careful men. The result was improved locomotive conditions, reduced engine failures, fewer personal injuries and a smaller ratio of locomotive repair cost to total operating revenue.

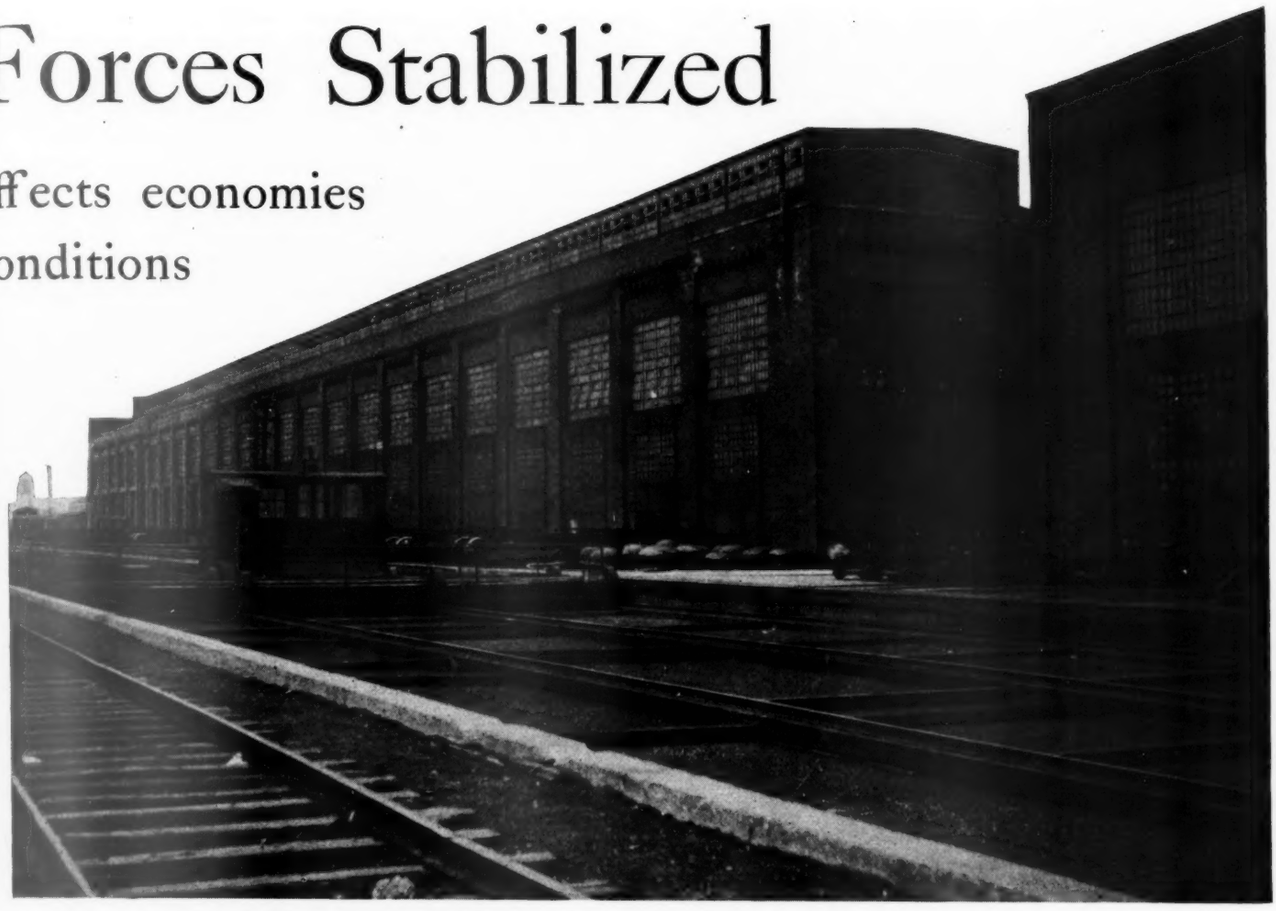
How the Budget Is Set Up

The basis of all budgets is first an estimate of the volume of business measured by revenues, car loadings, ton-miles, passenger miles, etc. These estimates are made by the traffic department which arrives at its estimate by careful reports from all off-line agencies as well as on-line agencies. These estimates are supplemented by estimated reports from local station agents and division superintendents. After all these reports are in, studied and analyzed, they are then compared with general national conditions, including the credit situation, cost of money, and forecasts by established and recognized authorities. The conclusions thus reached are then compared with the results in previous years and a final conclusion reached by the president regarding the probable business which will be transacted in the succeeding year. Gross revenues and cash receipts are estimated within approximately $300,000 each year, which is not a wide variation considering that operating revenues are annually in excess of $150,000,000.

Budgeting expenditures is in charge of a committee from each department appointed by the head of that department, and all budgets are consolidated, reviewed and properly approved by the executive. The establishment of a budget for the motive-power department requires a careful study of previous expenditures for running and classified repairs and a consideration of the actual locomotive miles to be run over a given period; also a careful estimate of the anticipated locomotive miles, based on prospective business, giving due consideration to the replacement of locomotives with gas and oil-electric units as well as locomotives to be purchased and retired. The desirability of a reasonable

Forces Stabilized

effects economies conditions



Chicago & North Western machine and erecting shop building at Chicago

increase in shop efficiency and reduction in locomotive maintenance costs also is not overlooked.

The total budget of the motive-power department for the year 1929, for example, being thus established, was divided between, labor, material, retirements and depreciation and distributed by months, as shown by the dotted lines on the budget-expense chart. The uniformity of the total expense budget of the motive-power department throughout the nine months of the year is well indicated in the upper curve. Reference to the percentage variation chart indicates that the actual total expense of the motive-power department exceeded the budget in only two months, namely February and May, the percentages being 0.72 and 2.51, respectively. The actual total expenditures of the motive-power department fell below the budget during the balance of the nine months, the widest variations occurring in April and July and amounting to 4.02 per cent and 6.39 per cent respectively. The primary cause for under-running the budget in these two months was reduced labor expense due to an unexpected number of absentees on account of vacations, sickness, etc.

An examination of the labor curve on the budget-expense chart indicates how closely the actual and the budget labor-cost lines follow each other. The labor budget was exceeded in only two months, namely February and May, and under-run in April and July, the maximum amount in the latter month representing 5.18 per cent of the budgeted labor expense. A glance at the labor curve may raise a question regarding its lack of uniformity throughout the nine months. Labor cost is directly proportional to the amount of time worked and the labor budget is based on the number of shop and enginehouse days to be worked in each month. February, for example, had only 22 working days in 1929 as compared with 26 days in May and 27 days in August. Moreover, the effect of any wage increase must be shown in the labor budget and in the case of the North Western an increase of approximately 4½ per cent was effective beginning with the month of May. Absentees, particularly during July and August were also influential in causing the actual expense of the motive-power department to be less than the budget allowance.

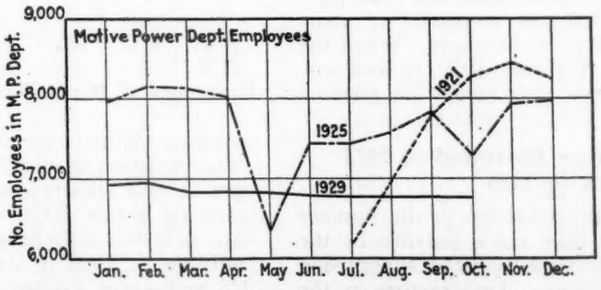
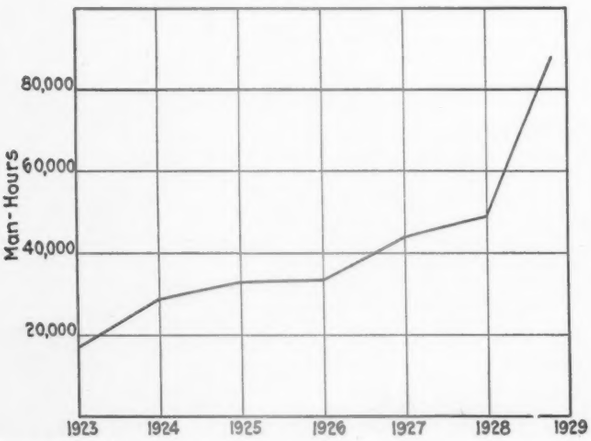


Chart clearly picturing extent to which North Western locomotive forces have been stabilized

Not much can be said about variations in the material-budget curve. Anticipated expenditures for material are set up, which are based more or less on the number of working days in each month. The holding over of material charged to

locomotives undergoing repairs from one month to another makes it particularly difficult to distribute the material monthly expenditures accurately. The material budget is also affected by wage increases, the present ratio of total labor and material costs in the North Western motive-power department being about 67 per cent for the former and 33 per cent for the latter.

Retirements and depreciation can be predicted with considerable certainty. The reason for the peak budget requirements in June was that locomotive retirement charges for the entire year were scheduled to be carried in this one month whereas they were actually carried over until later in the year. Since labor is the largest single factor in the total expense of the motive-power department, it is to be expected that the percentage variation in grand total expense will more or less follow the percentage variation in labor cost. This is well indicated in one of the charts.

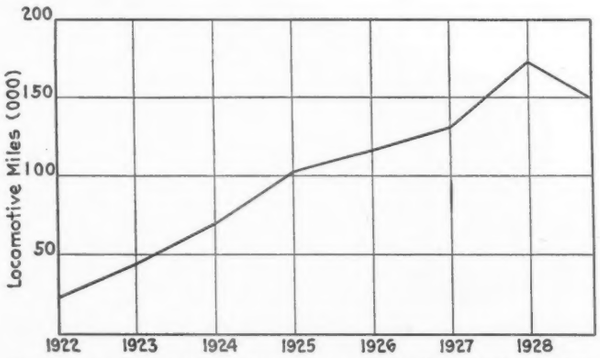


Average man-hours per personal injury involving the loss of one or more days, 1923 to date

The average man-hours per month for selected classifications in the North Western motive-power department is shown in one of the tables. This tabulation started with the 12-month period prior to June 1, 1922, at which time considerable reorganization was necessary on account of the shopmen's strike. Starting with the year 1923 an effort was made to maintain a stabilized force. This was fairly well worked out during the years 1923 and 1924. However, during 1925 there was a considerable falling off in business handled and retrenchment appeared to be necessary, with the result that there were a number of shut-downs in the shops and a curtailment of enginehouse forces. This reacted to such an extent that there was a surplus of bad-order power at the beginning of the year 1926 and it was necessary once more to build up the force to overcome this deferred maintenance. With this accomplished, the forces worked during the years 1927 and 1928 were fairly constant at a lower level as a result of many permanent reductions which could be made. When the budget was established for the year 1929, it was possible to establish a permanent force somewhat reduced below the previous years.

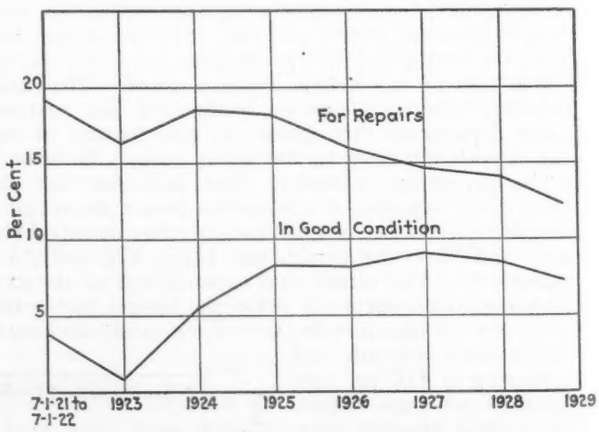
Locomotive Maintenance Borrowed in 1925 Paid Back in 1926

Referring to the table, the reduction in the number of foremen man-hours has been made possible by the reduced volume of work and the reduced supervision necessary with stabilized forces. Two factors in the decrease of blacksmith man-hours from about 35,000 to about 24,000 has been the increased use of the Oxygraph mechanical-torch cutting machine and of automatic electric welding heads and in spite of the increase of reclamation work requiring blacksmith operations. The installation of a modern spring-manufacturing plant at the Chicago shops of the North Western has also been a factor. Boiler work has decreased substantially, due, for one reason, to the increase in water treatment and in spite of an extensive boiler building program carried on in 1927 and 1928. The primary reason for the increase in electrical workers, which include both crane operators and electricians has been



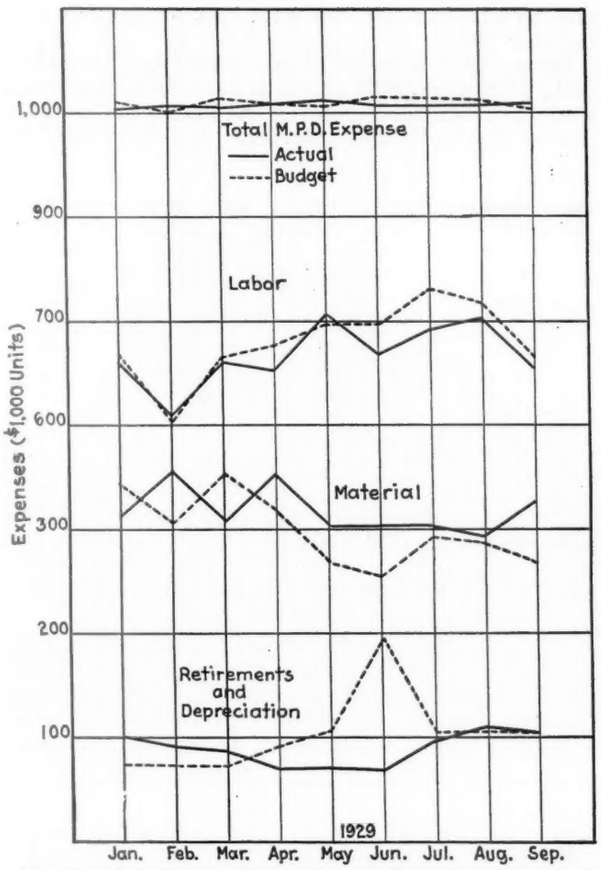
Record of locomotive miles per engine failure, 1922 to date

the extensive application of automatic train-control equipment to locomotives. This work is done at the Chicago shops and requires the services of a considerable number of experienced electrical workers and helpers whose work is carefully co-ordinated to assure the satisfactory application of train-control equipment without unnecessarily delaying locomotives. There has also been a substantial increase in the number of electrical workers employed on the line to inspect and maintain train-control equipment. The number of machinist man-hours as well as the helpers has varied in quite the same way as the boilermakers. The building up of work in 1923 is indicated and the subsequent borrowing of maintenance in 1925 to be paid back in 1926.



Percentage of North Western locomotives out of service

The variation in monthly man-hours over a period of years is also shown graphically in one of the charts. Referring to this chart, the concentrated effort to overcome deferred maintenance and improve locomotive conditions in 1923 is indicated, also the depression in 1925 and again a slight upbuilding of forces in 1926. The subsequent reduction has been made possible by

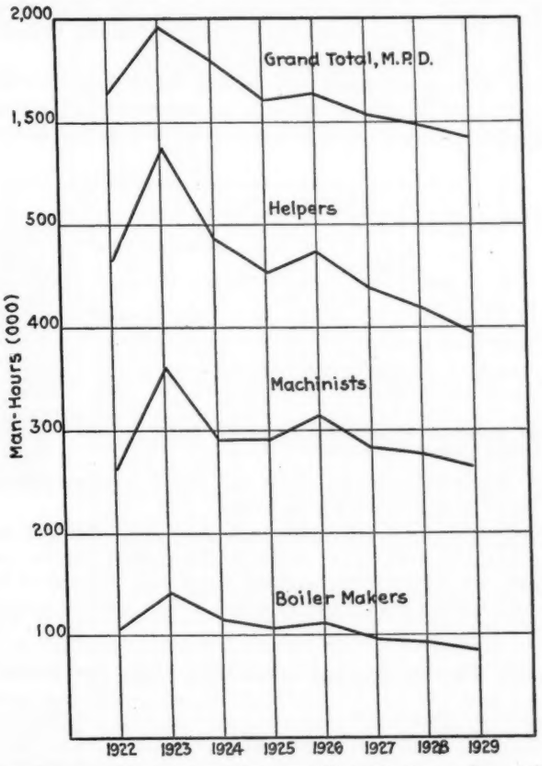


Actual and budget expenses for the first nine months of 1929—Motive power department

more efficient operation, improved machine equipment and material-handling methods and is now approaching a minimum consistent with keeping locomotives up to the desired high standard of maintenance.

To indicate to what extent the forces in the motive-power department of the Chicago & North Western have been stabilized, one of the charts shows the number of men employed for the last six months of 1921, for the year 1925 and for the first nine months of the year 1929. In 1921 the force was built up from a 6,184 to 8,435 in a period of six months. In 1925 the fluctuations were from 8,164 maximum to 6,345 minimum. In 1929, on the other hand, the fluctuation was only from 6,956 to 6,776 and this variation was caused by the closing of two small shop points.

By having men available during periods of slight depression, stabilization of forces permits preparing locomotives for subsequent peak demands. Increased forces are not then necessary and it has been established that power can be maintained at a higher standard throughout the year with a reduction in the total number of men employed.



Average man-hours per month—Selected classes in motive power department

Many improved facilities for economically handling the work have been a factor in obtaining reduced cost of locomotive maintenance, but the greatest factor involved is that of the stabilization of forces and im-

Average Man-Hours Per Month—Selected Classifications—Chicago & North Western Motive-Power Department

I. C. C. No....	Foremen 61	Asst. foremen 62	Black-smiths 68	Boiler-makers 69	Car men ** 70-71-72	Elec. workers * 74-75	Machin-ists 77	Mechanical helpers 80	Helper and reg. appren. 81-82	Laborers 83-85-86	Grand total
Year											
1921-1922	5,904	61,024	22,713	106,449	63,830	24,898	260,857	467,819	40,891	422,726	1,650,725
1923	4,757	66,908	35,039	142,455	76,047	29,597	361,088	577,305	61,283	419,477	1,977,390
1924	4,364	66,583	28,205	116,464	67,900	26,535	392,251	488,062	56,858	370,579	1,700,598
1925	4,282	65,406	28,728	108,292	63,042	26,759	291,452	456,732	57,518	325,342	1,601,731
1926	4,215	66,115	30,696	111,110	66,672	27,105	313,061	473,752	60,974	311,428	1,641,568
1927	3,883	66,365	26,253	95,572	62,155	29,643	283,590	439,113	52,751	314,292	1,544,202
1928	3,890	65,654	26,389	91,870	60,423	32,632	278,229	420,250	52,336	293,324	1,494,975
1929											
1 mo.....	3,744	66,096	26,723	86,720	58,217	34,420	278,557	404,143	52,656	285,791	1,469,506
2 mo.....	3,628	62,532	24,824	82,480	55,652	32,381	263,657	385,041	49,331	277,293	1,401,156
3 mo.....	3,597	63,451	25,024	84,011	56,669	32,862	267,157	391,268	49,418	281,971	1,421,843
4 mo.....	3,556	63,308	25,158	84,676	56,821	32,989	268,746	393,493	49,795	278,397	1,423,609
5 mo.....	3,552	63,658	25,162	85,124	57,242	33,203	270,028	395,653	49,841	279,824	1,430,619
6 mo.....	3,523	63,906	24,861	84,385	56,962	33,060	267,641	393,664	48,950	278,733	1,422,182
7 mo.....	3,531	64,759	24,737	84,294	57,007	33,012	266,967	394,354	48,506	279,393	1,423,592
8 mo.....	3,553	69,187	24,793	84,381	57,155	33,091	267,377	396,261	48,270	280,324	1,427,979
9 mo.....	3,526	64,800	24,548	83,808	56,944	32,903	265,560	394,158	47,541	279,180	1,419,655
	—364	—854	—1,841	—8,062	—3,479	+304	—12,669	—26,092	—4,795	—14,144	—75,320

Last line shows increase (+) or decrease (—) over previous year (1928).
* Crane operators and electricians. ** Locomotive carpenters, truck repairers and painters.

proved morale among the employees. The railroad has not benefited alone, however. As never before in the history of the North Western, the present force of locomotive men are sure of steady employment and are in a position to budget their own personal expenses.

One of the important advantages of stabilization from the point of view of a uniformly high standard of locomotive maintenance is indicated in the chart showing percentage of power out of service for repairs and in good condition, indicating that the gradual reduction in shop forces on the Chicago & North Western has not sacrificed the condition of power.

For example, during the period from July 1, 1921, to July 1, 1922, the percentage of power out of service for repairs was 19.3 This has been gradually reduced

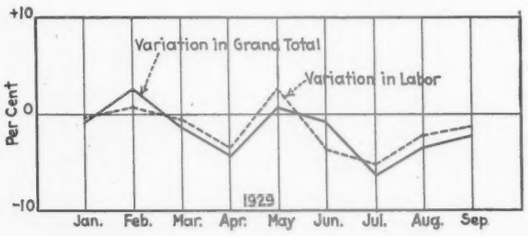


Chart showing percentage variations from budget estimates —Motive power department

with slight fluctuations until for the first nine months of 1929 it was but 11.8 per cent.

In spite of the reductions indicated in the budget and man-hour charts, the average locomotive miles per month for each of the various years has decreased but slightly from a maximum of 4,467,434 in 1924 to a minimum of 3,945,302 in 1928. This means that the total volume of motive-power maintenance work has not substantially decreased and thus accounted for the decrease in monthly man-hours.

Table Showing Average Locomotive Miles Per Month

Year	Miles per month
July 1, 1921—July 1, 1922	4,003,950
1923	4,467,434
1924	4,163,065
1925	3,982,768
1926	4,123,607
1927	3,979,491
1928	3,945,302
9 months 1929	3,990,994

Over 170,000 Miles Per Engine Failure Were Attained in 1928

The improved condition of locomotives is also indicated by the increased miles per engine failure as shown in another of the charts. During the year ending July 1, 1922, the average miles per engine failure was 35,046, this being quite sharply increased until 1925 and then more gradually to a maximum of 173,420 in 1928. This was an exceptional year, and the first nine months of 1929 shows a decrease to 149,622. Even this figure, however, shows what can be accomplished with a stabilized force for the more effective handling of both running and heavy repairs. The North Western definition of an engine failure is one which causes a 10-minute delay not subsequently made up. Another outstanding result of stabilized forces is indicated by the reduction in personal injuries, one of the charts showing definitely what has been accomplished. This chart is preprepared to indicate the monthly man-hours per accident in the motive-power department. The accidents reported are all instances in which there was a loss of one day's time or more and have been so recorded since the year 1923.

During 1923, a period of extremely large labor turnover, there were 57.65 accidents per million man-hours worked. This labor turnover and fluctuation in force, due to shutdowns and reductions, has gradually decreased since 1923, with a highly favorable effect in decreased accidents per million man-hours from 57.65 in 1923 to 11.76 in 1929.

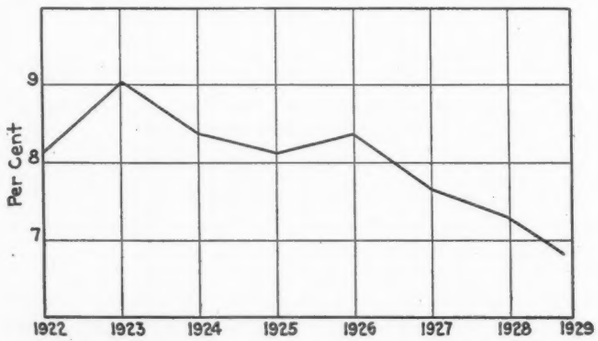
Table Showing Personal Injuries on a Million Man-Hour Basis

Year	Average man-hours per month	Average accidents per month *	Accidents per million man-hours
1923	1,977,390	114	57.65
1924	1,700,598	70	41.17
1925	1,601,731	49.4	30.84
1926	1,641,568	49.6	30.22
1927	1,544,202	35.1	22.73
1928	1,494,975	30.9	20.66
9 mo. 1929	1,419,655	16.7	11.76

* Accidents causing loss of one day's time or more.

Repair Cost Reduced to 6.82 Per Cent of Operating Revenues

The economies actually effected by the stabilization of shop forces are shown in a chart which indicates the ratio of expenditures for locomotive repairs to the total operating revenue over the period under consideration. In spite of the fact that during the period there have been three successive wage increases, the ratio has been gradually reduced from a peak of 9.2 per cent in the year 1923, to 6.82 per cent for the first nine months of the year 1929.



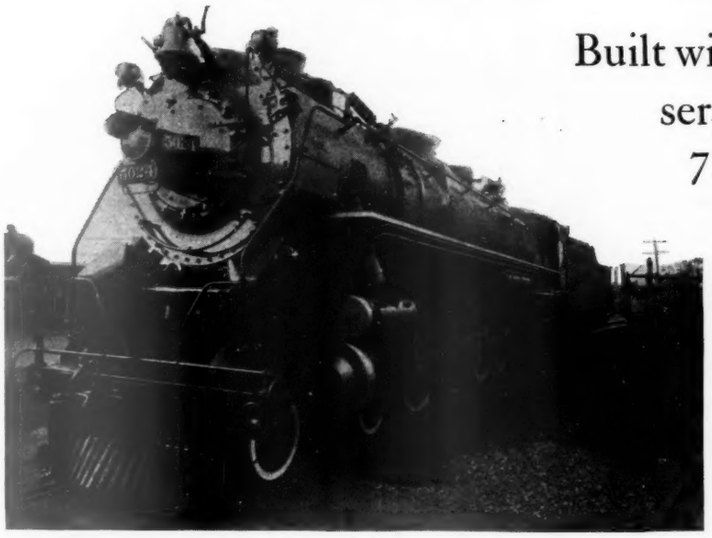
Ratio of locomotive repairs to total operating revenue

It is conceded that a certain percentage of the total operating revenue must be available for locomotive repairs. This ratio will vary in different territories and for different railroads, depending on the service performed and the type of locomotive operated. However, any program which tends to a continued reduction of this ratio, and at the same time contributes to steady employment and improved working conditions for the men, as has occurred on the Chicago & North Western, recommends itself for serious consideration.

CUTTING TOOLS.—Many new and useful standard cutting tools and holders, as well as many distinctive and individual special tools for intricate operations, are shown in the latest catalogue, No. 20, of the Gairing Tool Company, 1629 Lafayette boulevard, Detroit, Mich. The catalogue contains 124 pages and is attractively bound in a dark blue cover, embossed in gold. New list prices are given on standard tools.

4-8-4 Type Locomotives for the Rock Island

Built with 69-in. drivers for freight service—For passenger service 74-in. drivers can be applied



One of the 4-8-4 type locomotives built for the Rock Island by the American Locomotive Company

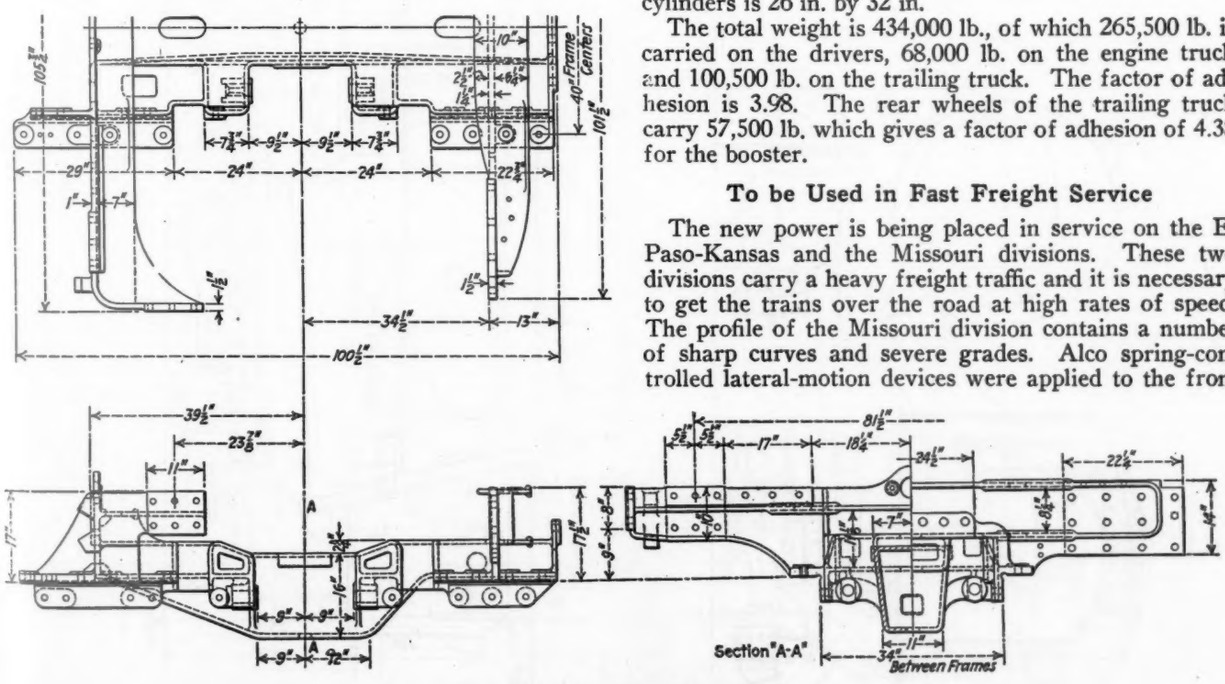
THE Chicago, Rock Island & Pacific now has in service 24 4-8-4 type locomotives, in the design of which are incorporated a number of unique features. It was the desire of the railroad company to produce a locomotive the detail design of which would in general, be suitable for either freight or passenger service. Such a design, it was considered, would not only be economical from the standpoint of maintenance, but would result in having interchangeable parts for two classes of locomotives, thus reducing the number of locomotive parts necessary to be carried in stock. As a result a 4-8-4 type was designed for freight service having 69 in. drivers. The driving-wheel base, together with the related parts, i. e., cylinders, side rods, boxes, etc., were designed so that 74-in. drivers could be applied should it be desired to use the locomotive in passenger service.

This order of 24 locomotives, which were built by the American Locomotive Company, is a repeat order of a single locomotive, No. 5000, delivered last February. They develop a maximum rated tractive force of 66,000 lb. Franklin boosters are applied to the rear trailer truck wheels which develop a tractive force of 13,100 lb. This gives a combined tractive force at starting of 79,100 lb. The boiler operates at a pressure of 250 lb., and the diameter and stroke of the cylinders is 26 in. by 32 in.

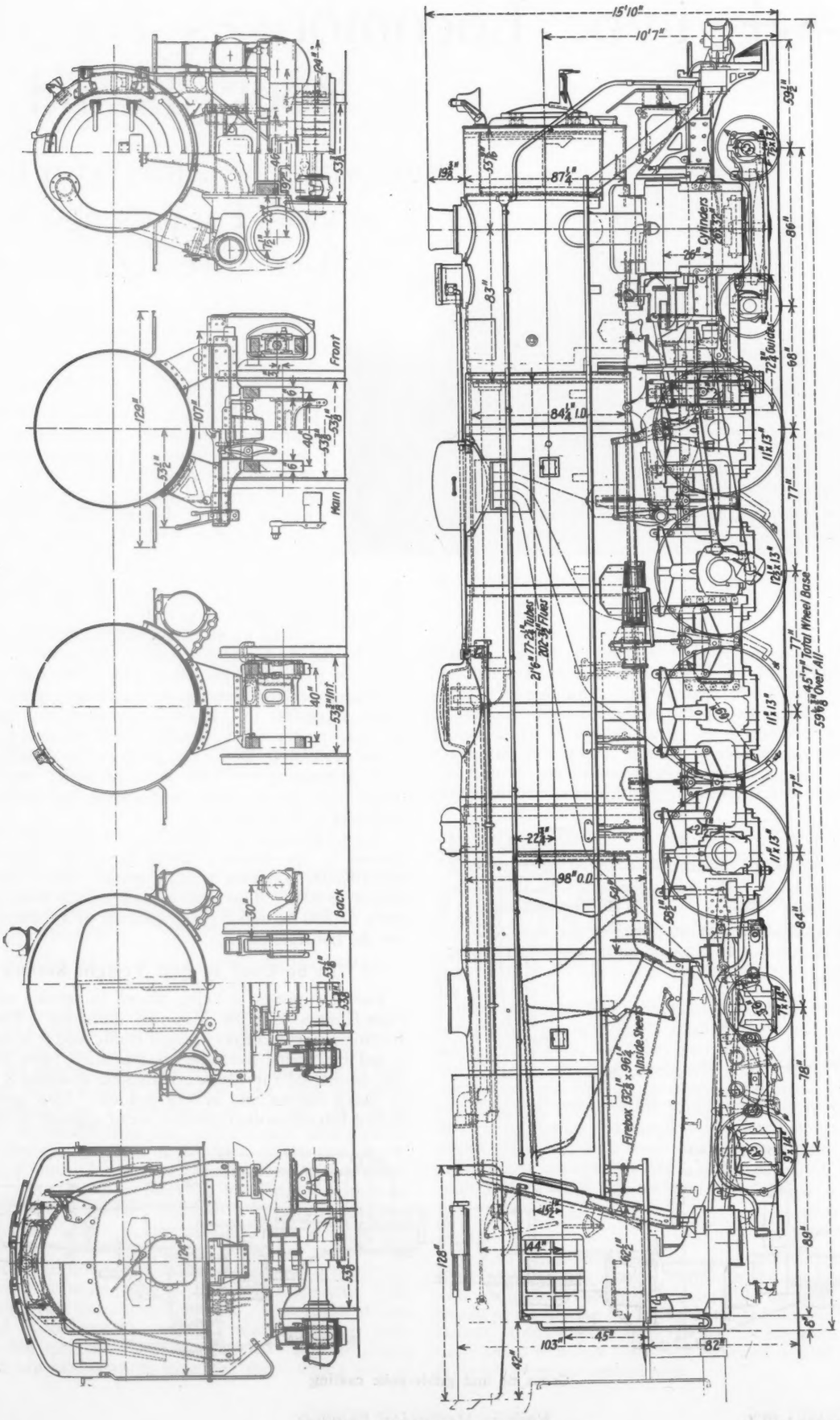
The total weight is 434,000 lb., of which 265,500 lb. is carried on the drivers, 68,000 lb. on the engine truck and 100,500 lb. on the trailing truck. The factor of adhesion is 3.98. The rear wheels of the trailing truck carry 57,500 lb. which gives a factor of adhesion of 4.38 for the booster.

To be Used in Fast Freight Service

The new power is being placed in service on the El Paso-Kansas and the Missouri divisions. These two divisions carry a heavy freight traffic and it is necessary to get the trains over the road at high rates of speed. The profile of the Missouri division contains a number of sharp curves and severe grades. Alco spring-controlled lateral-motion devices were applied to the front



Cross tie and guide-yoke casting



Elevation and cross sections of the Rock Island 4-8-4 type locomotives

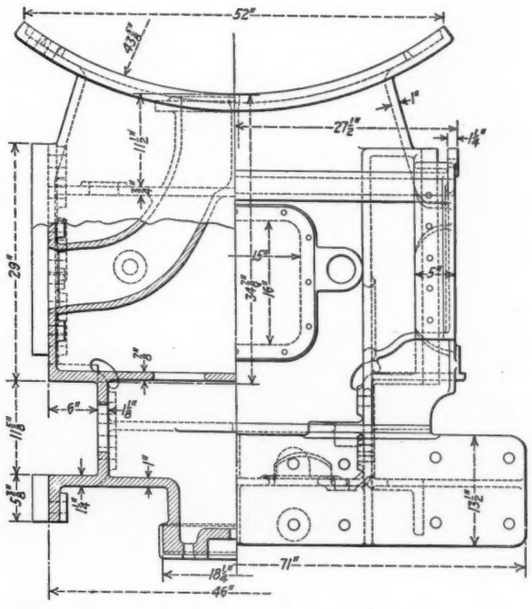
driving wheels, and inside-bearing, cast-steel, geared roller-resistance engine trucks were also applied.

Features of the Design

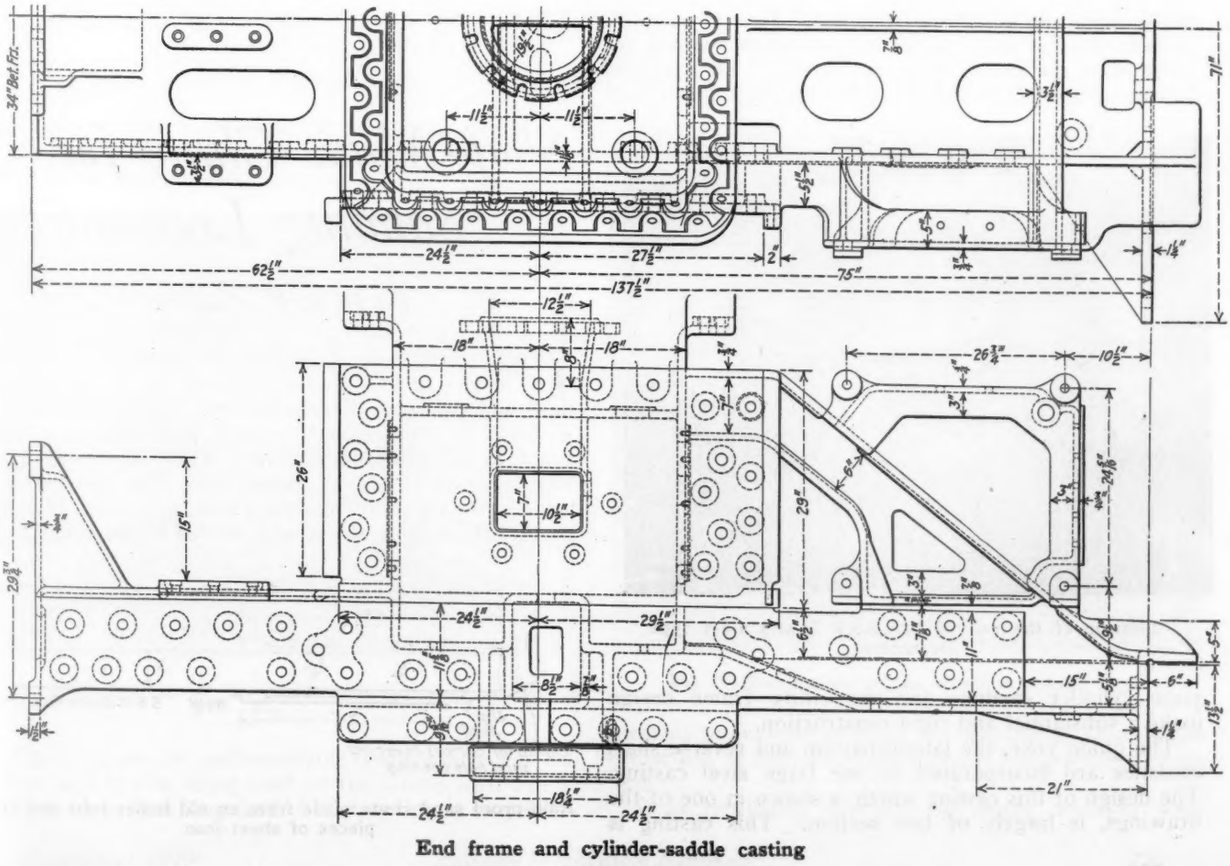
A feature of the design of these locomotives is the front bumper-bracket casting, which is shown in one of the drawings. The cylinder saddle, the front portion of the frame and the brackets for the air compressors, which are located in the front of the cylinders immediately back of the bumpers, are cast integral with the bumper bracket. The main frame is of the usual rectangular bar section, but it differs somewhat from the

Table of Dimensions, Weights and Proportions of the Chicago, Rock Island & Pacific 4-8-4 Type Locomotives

Railroad	C. R. I. & P.
Builder	American Locomotive Company
Type of locomotive	4-8-4
Service	Freight
Cylinders, diameter and stroke	26 in. by 32 in.
Valve gear, type	Baker
Valves, piston type, size	12 in.
Maximum travel	8⅜ in.
Outside lap	1⅝ in.
Exhaust clearance	Line and line
Lead in full gear	¼ in.
Weights in working order:	
On drivers	265,500 lb.
On front trucks	68,000 lb.
On trailing truck, rear wheels	57,500 lb.
On trailing truck, front wheels	43,000 lb.
Total engine	434,000 lb.
Tender	299,200 lb.
Total engine and tender	733,200 lb.
Wheel bases:	
Driving	19 ft. 3 in.
Total engine	45 ft. 7 in.
Total engine and tender	88 ft.
Wheels, diameter outside tires:	
Driving	69 in.
Front truck	33 in.
Trailing truck, front	36 in.
Trailing truck, rear	43 in.
Journals, diameter and length:	
Driving, main	12½ in. by 13 in.
Driving, others	11 in. by 13 in.
Front truck	7½ in. by 13 in.
Trailing truck, front	7 in. by 14 in.
Trailing truck, rear	9 in. by 14 in.
Boiler:	
Type	Straight top
Steam pressure	250 lb.
Fuel, kind	Soft coal



Cross section at center line and end view of cylinder saddle casting



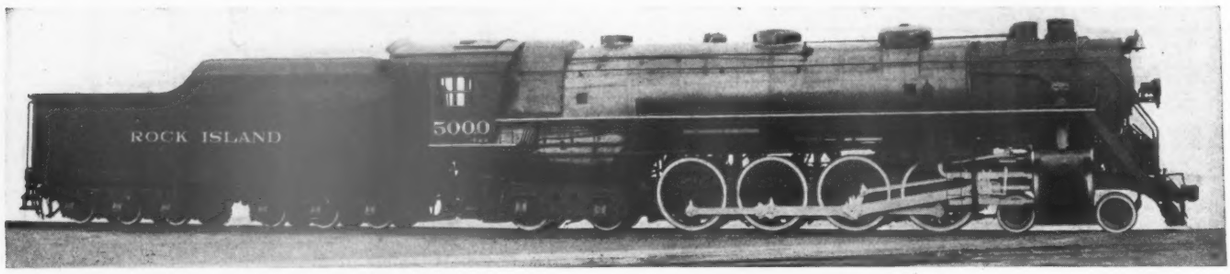
End frame and cylinder-saddle casting

Diameter, front ring, inside	84¼ in.
Firebox, length and width	132⅛ in. by 96¼ in.
Combustion chamber, length	54 in.
Tubes, number and diameter	77—2¼ in.
Flues, number and diameter	202—3½ in.
Length over tube sheets	21 ft. 6 in.
Grate area	88.3 sq. ft.
Heating surfaces:	
Firebox and combustion chamber	364 sq. ft.
Syphons	151 sq. ft.
Tubes and flues	4,928 sq. ft.
Total evaporative	5,443 sq. ft.
Superheating	2,243 sq. ft.
Combined evaporative and superheat	7,686 sq. ft.
Tender:	
Water capacity	15,000 gal.
Fuel, capacity	20 tons
Wheels, diameter outside tires	33 in.
Journals, diameter and length	6½ in. by 12 in.

bolted to the front bumper bracket as well as to the main frames and brake-shaft crosstie, and produces a rigid construction. Both the front and rear ends of the firebox are supported on sliding shoes. The room provided in the cab for the engine crew is more spacious than that on the usual design of locomotive. This feature, together with the location of the valves, gages, etc., has proved to be a satisfactory arrangement.

Special Equipment

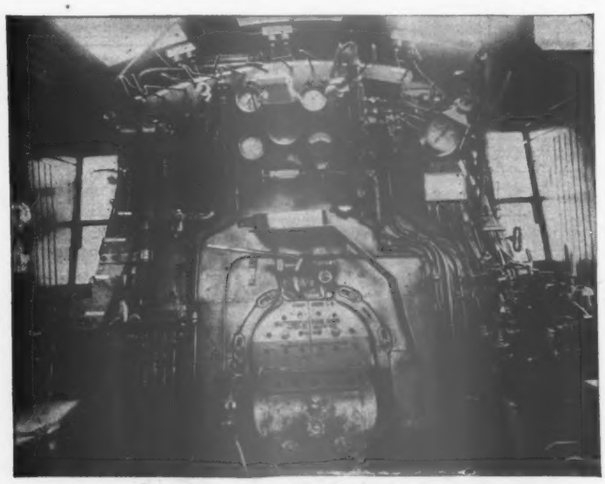
Flow of steam to and from the cylinders is controlled by a Baker valve gear having a piston diameter of 12



The trial locomotive placed in service last February

Maximum rated tractive force	66,000 lb.	
Rated tractive force of booster	13,100 lb.	
Combined tractive force at starting	79,100 lb.	
Weight proportions:		
Weight on drivers ÷ total weight engine, per cent		61.3
Weight on drivers ÷ tractive force		3.98
Total weight engine ÷ comb. heat. surface		56.5
Boiler proportions:		
Tractive force ÷ comb. heating surface		8.68
Tractive force × diam. drivers ÷ comb. heating surface		598
Firebox heating surface ÷ grate area		5.84
Firebox heat. surface, per cent of evap. heating surface		9.47
Combined heating surface ÷ grate area		86.9

conventional design at the front end. The cylinder rail is continuous as in previous designs but is set in a depression of the frame front-end casting. This permits bolting and keying directly to the casting. The three-piece cylinder castings and the entire frame design make a substantial and rigid construction.



Interior of the cab of the Rock Island 4-8-4 type locomotive

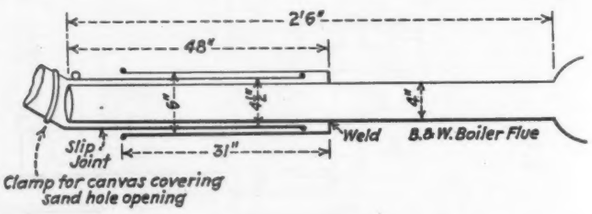
The guide yoke, the lateral-motion and reverse shaft crossties are incorporated in one large steel casting. The design of this casting which is shown in one of the drawings, is largely of box section. This casting is

in. In addition to the devices already mentioned, these locomotives are equipped with Alco Power reverse gears, cast-steel bumpers, rear cradle, trailing truck tender frame and trucks. Additional equipment includes the BK type Standard stoker, the engine of which is located on the tender; Coffin feedwater heater, Chambers front-end throttle, four Thermic syphons, two of which are located in the firebox and two in the combustion chamber, and a Type E superheater. The tender has a capacity of 15,000 gal. of water and 20 tons of coal.

Shop-Made Chute for Sanding Locomotives

By Wm. F. Zwiebel

THE sand chute shown in the sketch has been in service at this engine terminal for a considerable time and has proven satisfactory. Although its construction is comparatively simple, it is rain and snow proof in all kinds of weather. This chute was made from a scrapped B. & W. boiler tube. The slip-joint was made in the tin shop from sheet iron, about No. 14 B.W. gage. The outside sleeve was welded to the boiler tube,



Rain-proof sand chute made from an old boiler tube and two pieces of sheet iron

making a water-tight joint. The inside sleeve is formed with an elbow, to which a piece of canvas, large enough to cover the sand box opening, is clamped. The hostler can easily raise the edge of the canvas to see when the box is full, without wasting sand. An old piece of cab curtain, about 20 in. square, is satisfactory.

Gages for Centering Wheels on Axles

By A. F. Coulter

Master Car Builder, Union Railroad, East Pittsburgh, Pa.

PARAGRAPH 242 of the A.R.A. Wheel and Axle Manual recommends that wheels be mounted central on the axle as a protection against flange wear and hot boxes. Thus, it is necessary to find the exact center of the axle in order to mount wheels in accordance with the A.R.A. recommended practice.

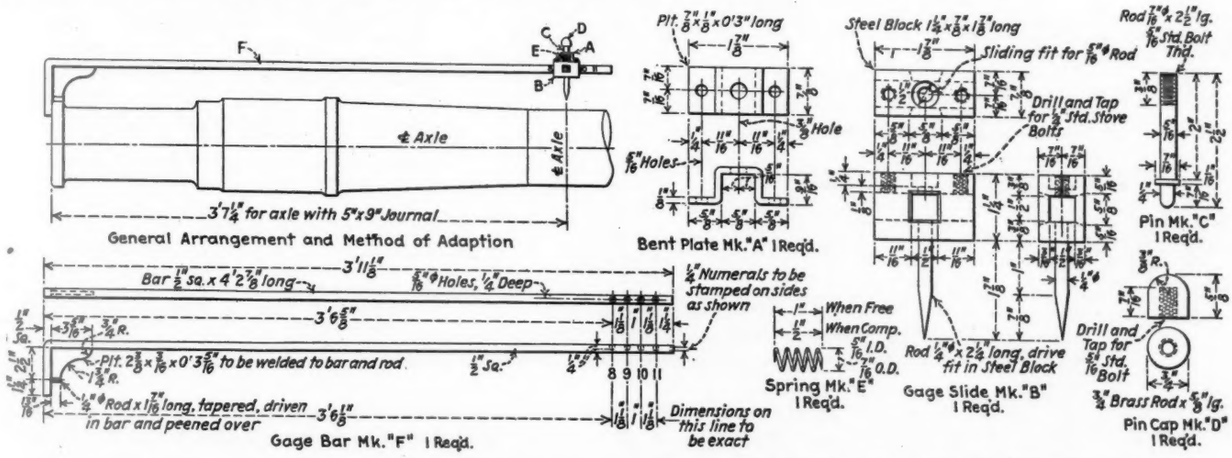

General Arrangement and Method of Adaption
Bent Plate Mk."A" 1 Req'd.
Gage Bar Mk."F" 1 Req'd.
Spring Mk."E" 1 Req'd.
Gage Slide Mk."B" 1 Req'd.
Pin Mk."C" 1 Req'd.
Pin Cap Mk."D" 1 Req'd.
Dimensions on this line to be exact

Fig. 1.—Drawing showing the general arrangement application and details of the axle centering gage

Fig. 2—Application of the axle-centering gage shown in Fig. 1

Fig. 1 shows an axle-centering gage which was designed and is now being used on the Union, that can be applied to present standard A.R.A. axles having 8-in., 9-in., 10-in. or 11-in. journals. It is made of a ½-in. square steel bar on which is mounted a sliding steel block. This block has an opening on each side through which the operator can observe the length of journal for which the gage is set. It can be moved to any one of the desired journal lengths by operating a plunger pin, which is held against the bar by a spring. The plunger pin is allowed to drop into one of the holes on the gage bar, which are identified by numerals stamped on the side of the bar, according to the length of journal the operator is working on. A rest is provided at one end of the gage, which is placed on the top of the axle collar, as shown in Fig. 2.

Fig. 4 shows the method of application and detail construction of the gage used for mounting wheels. The application of this gage is further illustrated in Fig. 3. The gage is applied to the wheel as shown and is secured to the wheel by moving down the lever *A*. This lever rotates the cam *K* which clamps the gage to the wheel, the bearing joints of the gage clamp on the wheel being indicated by the letters *D*, *B* and *C*.

The pointer is a hardened steel pin, which is held in position by the guide spring *L*. It is mounted on a bracket *N*, which is designed to permit a swinging move-

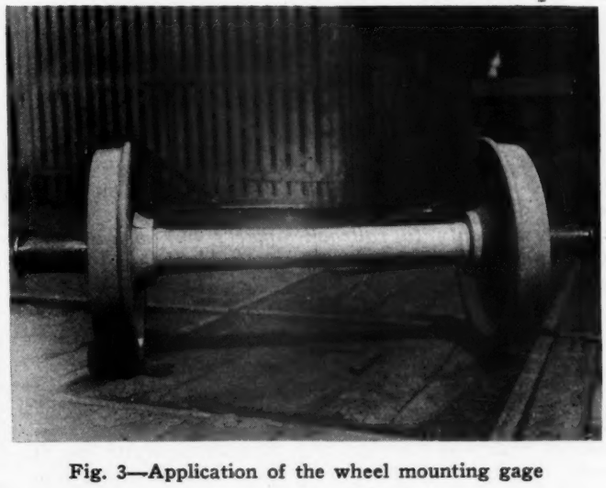


Fig. 3—Application of the wheel mounting gage

ment of the pointer to assist the operator in locating the center line of the axle as the wheel is being pressed on its seat.

It is frequently desirable to mount wrought steel

wheels prior to turning the tread and flange, on which the tread has been rolled out over the outside edge. No difficulty has ever been encountered in applying the gage to wheels in this condition, because the bearing joint *D* always comes below the metal that has been rolled out over the edge. This gage can also be used on cast-iron wheels with reinforced flanges, with a slight modification in the location of the bearing points *C* and *D*, of the gage on the car wheel.

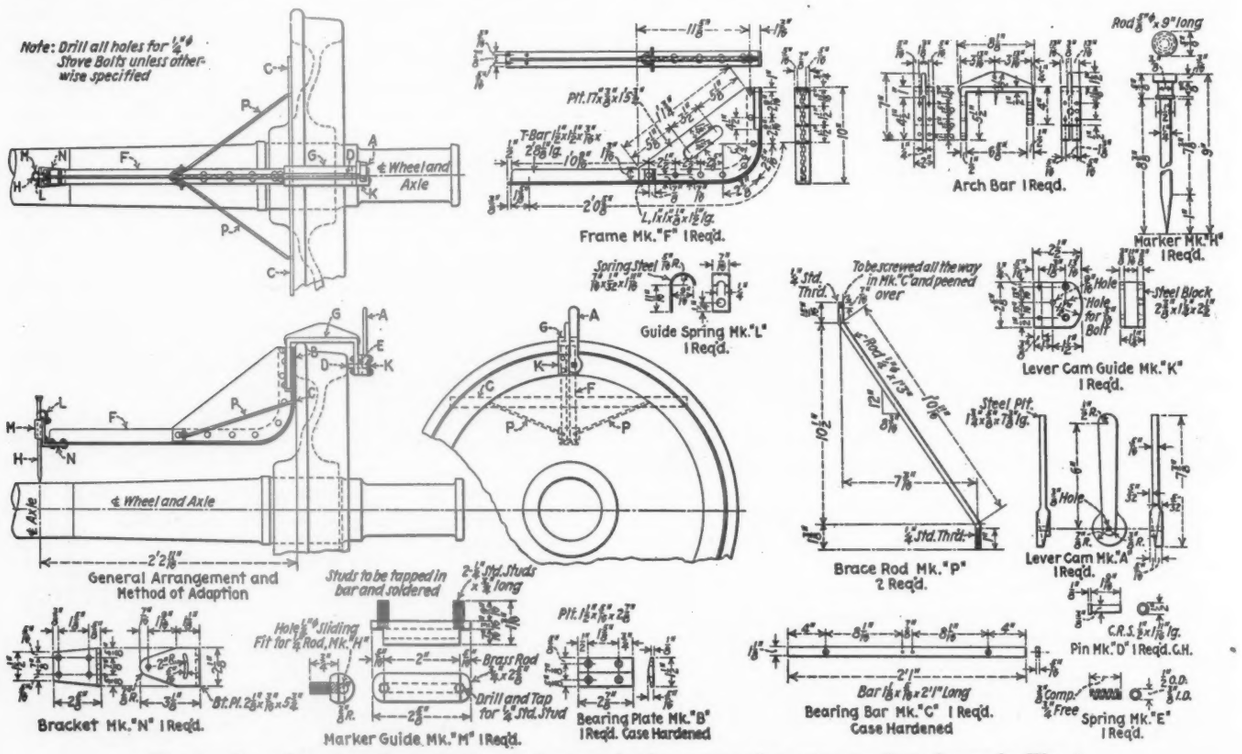

Note: Drill all holes for ½" Stove Bolts unless otherwise specified
℄ Wheel and Axle
Frame Mk. "F" 1 Req'd.
Arch Bar 1 Req'd.
Rod ⅝" x 9" long
Marker Mk. "H" 1 Req'd.
Guide Spring Mk. "L" 1 Req'd.
Lever Cam Guide Mk. "K" 1 Req'd.
Steel Block
Hole for Bolt
To be screwed all the way in Mk. "C" and peened over
Brace Rod Mk. "P" 2 Req'd.
Lever Cam Mk. "A" 1 Req'd.
Steel Plt.
Pin Mk. "D" 1 Req'd. C.H.
Spring Mk. "E" 1 Req'd.
Bar ⅛" x 2" x 21" long
Bearing Bar Mk. "C" 1 Req'd. Case Hardened
General Arrangement and Method of Adaption
Studs to be tapped in bar and soldered
Bracket Mk. "N" 1 Req'd.
Marker Guide Mk. "M" 1 Req'd.
Bearing Plate Mk. "B" 1 Req'd. Case Hardened
Brass Rod
Drill and Tap for ⅝" Std. Stud

Fig. 4—Gage for mounting wheels—This gage is the compa nion gage to that shown in Fig. 1

reported a number of improper repairs, and also a number of defects caused by the derailment that had not been repaired. After the joint inspection at East St. Louis the car was made empty and forwarded to the General American Tank Car Corp. shops at East Chicago, Ind., where complete repairs were made. No bill was rendered against the owner by the Texas-Mexican for the repairs it made to the car. On October 25, 1927, a bill was made against the Texas-Mexican in accordance with A.R.A. Rule 12, covering the cost of correcting and making complete repairs to the car. The railroad claimed that correct repairs had been made and refused to honor the bill. It stated that the Quaker City Tank Line waved inspection by its representative and in lieu thereof the railroad had a joint inspection made by the Texas-Mexican and I.G.N. inspectors. These inspectors pronounced the car OK for service, for which the railroad produced a joint evidence card as evidence.

The Arbitration Committee rendered the following decision, "The Texas-Mexican is responsible for the improper patches applied by them, as established by the joint evidence. With reference to the unrepaired details, in view of the Texas-Mexican having acknowledged the existence of 'bent and flattened places in circular sheets,' they are also responsible for this portion of the damage, and should issue a defect card for the same. The car owner's recourse for protection on any other unfair usage defects is against the delivering line, as provided in first paragraphs of Rules 2 and 4. See Decision No. 1318."—*Case No. 1609—Quaker City Tank Line, Inc., vs. Texas-Mexican.*

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Tank Car Damaged and Repaired Found Defective When Car Arrived Home

On November 4, 1926 the Texas-Mexican Railway advised the Quaker City Tank Line, Inc., that Q.T.X. tank car 9429 was damaged in a derailment on its line at Saenz, Texas, on October 7, 1926. The handling line repaired this car in its Laredo, Texas, shops December 8, 1926, and returned the car to the nearest home point of the owner, East St. Louis, Illinois, April 28, 1927. A joint inspection was made at this point by representatives of the C.C.C. & St. L. and the owner, who

Another Decision Involving Arbitration Case No. 1319

The Denver Joint Car Interchange and Inspection Bureau issued a defect card against the Denver & Rio Grande Western to the Union Pacific for one cut jour-

nal on Union Pacific car No. 26328. The repairs made by the Union Pacific consisted of one pair of new wheels mounted on a new 5½-in. by 10-in. axle, and a charge was made against the defect card, for the difference between the new wheels and axle applied and the second-hand wheels and axle removed. The Denver & Rio Grande Western objected to the betterment charge for the new wheels that were applied. It stated that the instructions in the Official Railway Equipment Register provided that repair charges for all Union Pacific System cars were to be included in one monthly bill against the Union Pacific Railroad, and in listing the cars on the billing statements no distinction is made of Union Pacific cars and Union Pacific System cars. The Union Pacific declined to make any adjustment basing its refusal on Arbitration Case No. 1319. It stated that each road comprising this system assumed in its own accounts its proper proportion of such expense together with its proper proportion of all costs incurred by the Union Pacific Railroad. It contended that the status of this arrangement, under the Interchange Rules, is in no wise different than any joint agent which might be established for convenience and economy by any two or more subscribers to the Interchange Rules, and is unable to differentiate between this arrangement in its relation to the provision of Rule 98 (b), and the method used by any other system of roads.

The Arbitration Committee in rendering its decision stated, "In view of the status of the roads comprising the Union Pacific System, the Union Pacific Railroad is not the owner of the car in question insofar as the application of Rule 98, Section (b), Paragraph 4, is concerned. The charge against the Denver & Rio Grande Western is, therefore, sustained." *Case No. 1608—Denver & Rio Grande Western vs. Union Pacific.*

Damaged Cars Should Be Held Intact for Owners Inspection

Southern Pacific car 24402 was reported by the Denver & Rio Grande Western as "destroyed in accident" on its line near Eagle, Colo., March 30, 1928. It claimed that the car failed under conditions of fair usage caused by the train breaking in two, there being no derailment in connection with the accident which made the owner responsible. This car was a 50-ton steel-underframe, single-sheathed box car built in September, 1913, and was less than 15 years old at the time of its destruction. The underframe construction consisted of channel side sills and double fish-belly center sills with a continuous cover plate. The Denver & Rio Grande Western notified the Southern Pacific that the sills and frame were broken and bent to such an extent that it was not believed that the car owners would wish to have the car repaired. A joint inspection certificate, showing the extent of the damage and the estimated cost to be $1,800, was submitted to the car owner, as the handling line considered it to be a case of the owner's responsibility under A.R.A. Rule 120. The owner of the car was not satisfied with this report of the accident, and had an inspection made by two of its car department officers. The result of the inspection of the wreckage was unsatisfactory because the center sills had been cut away from the underframe and shipped with the trucks, couplers and brakes to Pueblo, Colo. It was clear, however, that the destruction of the car was complete, but the car owner claimed that it could not understand how the damage could have been done under the conditions reported by the handling line. The Denver & Rio Grande Western contended that the fact, that the car body was cut loose from the underframe, did not enter into the question of responsibility for the damage for the reason that this operation would have been necessary had the car owner authorized repairs to the car.

The following decision was rendered by the Arbitration Committee. "The car was not subjected to unfair usage within the scope of Rule 32. The car owner is responsible." *Case No. 1610—Southern Pacific vs. Denver & Rio Grande Western.*

[The following note was appended to the report of this case: "When reporting a car for disposition under Rule 120, it is advisable to hold the car intact, or at least hold all portions of the car at one point, to afford the owner the opportunity to make inspection within the time if he so desires."—EDITOR.]

Air Motor Adapted to a Special Job

THE easy adaptability of the air motor to special jobs, in case of emergency, is shown in the illustration. It became necessary in a railroad shop to prepare a quantity of steel rails, 12 ft. long, with rivet holes spaced every few inches of the length. Several rails at a time were placed on two strong metal horses,

Utilizing an air motor for special work by mounting it on a swinging boom

of convenient height, under a swinging boom made of 8-in. I beam, with a stop block of metal riveted on top at the extreme end. A frame of ½ in. metal moves along the beam on two 4-in. metal rollers set on top of the beam. From a projection at each lower corner of the frame a strong coil spring is suspended, with a loop at the lower end to enclose the handles of the air motor which are held in vertical slots in extensions of the frame.

The feed wheel is held firmly against the middle of the frame by the pressure of two springs. The motor

handles are held against side motion by the frame extensions. By the use of this device a 12-ft. radius of operation was secured, and the drilling of the material easily managed by two workmen. The device became a permanent part of the shop equipment and is now used on many other similar jobs.

Special Valve-Seat Reamer for Booster

By W. H. Haynes

Tool and Air Brake Foreman Missouri Pacific, Kansas City, Mo.

ORDINARILY when it is necessary to ream a new valve seat in the booster main throttle valve, it is necessary to remove the heavy throttle and pipes from the engine. The illustration shows a valve-seat reamer which in a few minutes reseats the cage while the throttle valve is in place.

The device consists of the main stem *F* on one end of which is a shank for air-motor drive. On this stem are placed the two rosebud 33-flute reamers, *E* and *G* which are held in place by lock nuts *C*. The two reamers are spaced so as to ream the bottom and top valve seats in the cage at the same time.

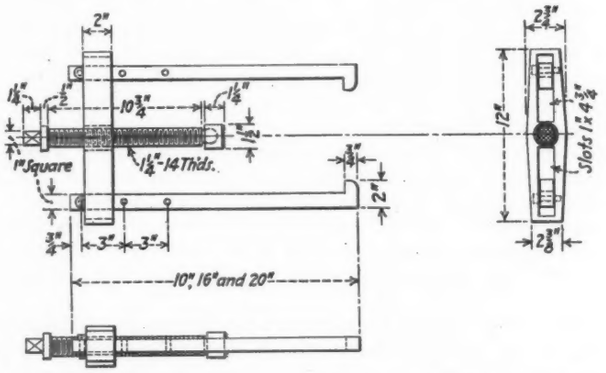
The cap over the valve is removed and the reamer inserted in place. Part *A* which is threaded to fit the valve-cap hole, is screwed in place. The lower end bears on the top surface of the rosebud reamer *G*. The tool is now free to turn in the cage. Either an air motor or a hand wrench may be used, depending on the condition of the valve seats.

Combination Gear and Bushing Puller

By H. H. Clark

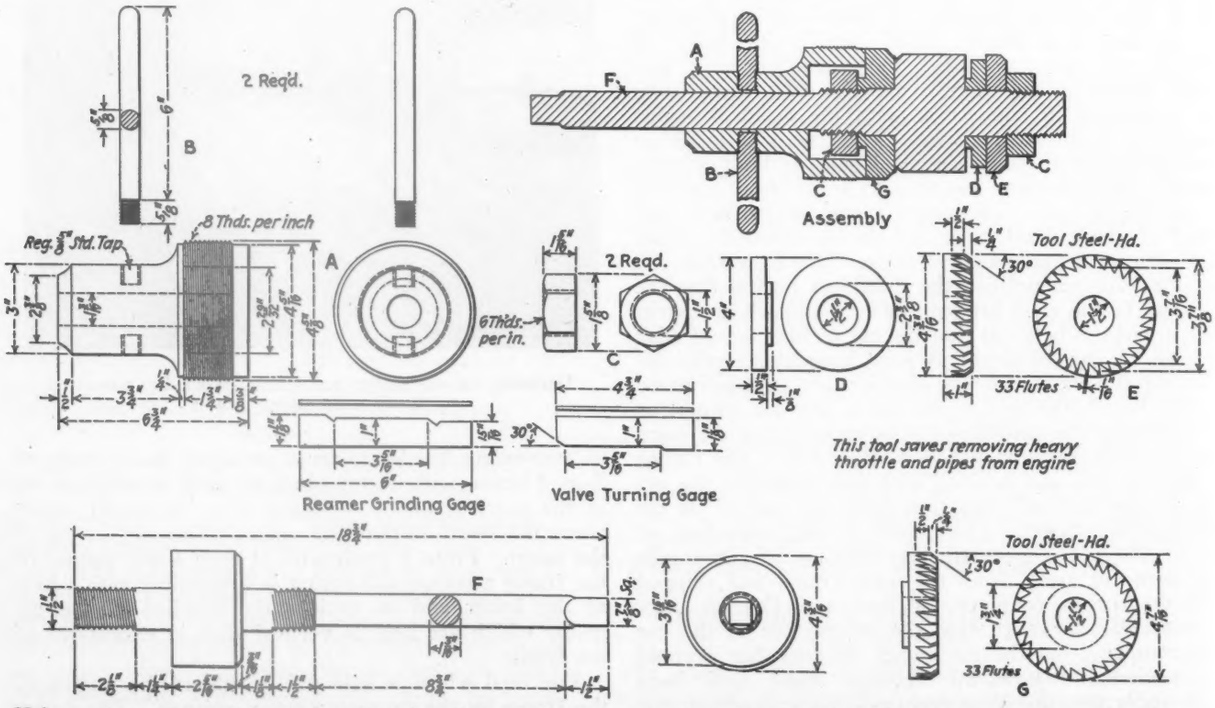
Machinist, Central of Georgia, Macon, Ga.

THE tool shown in the sketch is designed for pulling gears of different sizes. Any machinist employed as a millwright around a railroad shop will have frequent need for a tool of this kind. It can be made readily and



A convenient shop-made tool for pulling gears or bushings

at small cost. This tool has three sets of tongs of different lengths. Each tong is drilled with three ½-in. holes, spaced 3 in. apart, so that the length of the tongs may be adjusted to suit the job. Slots, 1 in. by 4¾ in., permit adjusting the tongs to suit the diameter of the gears to be pulled. Reversing the tongs in the slots so that the end lugs point out instead of in, converts the tool into a bushing puller.



Valve-seat reamer used for facing the valve seats of the booster main valve throttle without removing it or the pipe

Examples of Recent Passenger and Fast Freight Locomotives of the 4-8-2 Type

General Dimensions, Weights and Proportions

Railroad	U.S.	U.S.	Ban.		N.C.		M.St.P.		St.L.-	N.Y.			N.Y.		C.R.			
	R.A.	R.A.	&Ar.	S.A.L.	&St.L.	L.&N.	&S.S.M.	F.E.C.	S.F.	O.&W.	T.&P.	N.Y.C.	N.H.&H.	S.P.	I.&P.	Penna.	M.P.	B.&O.
Builder	A. & B.	A. & B.	Amer.	Bald.	Bald.	Bald.	Amer.	Amer.	Bald.	Amer.	Bald.	Amer.	Amer.	Am.&R.R.	Amer.	B.&L.	Amer.	R.R.
Road class	Light	Heavy	M	M-2	J1A-54	L-1	N-20	.....	T-54	....	M-2	L-2b	R-2a	Mt-1	M50	M1	...	T
Road number	... ..	.....	100	250	561	402	4012	815	1524	460	909	2743	3507	4300	4060	6800	5337	5500
Date built	1918	1918	1929	1925	1925	1926	1928	1926	1926	1929	1928	1929	1926	1929	1929	....	1927	1925
Tractive force, engine, lb.	53,900	58,000	50,000	48,200	53,800	53,900	53,900	60,800	54,100	60,620	54,700	60,620	68,000	57,100	50,400	64,550	63,665	65,000
Tractive force, booster or aux. loco., lb.	.....	.....	11,300	.....	.....	.....	10,750	.....	.....	11,250	10,450	12,400	.....	10,100	.....	.....	.....	.....
Cylinder horsepower (Cole)	2,624	2,824	2,186	2,624	2,624	2,624	2,624	2,965	2,824	2,952	2,820	2,952	3,476	2,965	2,824	3,280	3,280	3,406
Piston speed at 10 m.p.h.	243.5	243.5	271.0	217.8	243.5	243.5	243.5	243.5	227.2	243.5	230.2	243.5	243.5	231.8	211.9	233.4	230.2	227.1
ENGINE AND TENDER DATA																		
Weight of engine, lb.	327,000	352,500	303,000	320,900	326,950	333,100	342,000	356,000	358,690	360,000	361,400	364,000	362,500	368,000	378,000	382,400	394,000	400,000
Weight on drivers, lb.	224,500	243,000	204,000	213,450	217,970	223,950	231,500	244,500	245,170	239,500	245,600	244,000	246,000	246,000	255,500	266,500	264,500	275,000
Weight on front truck, lb.	49,500	51,500	48,000	57,480	52,330	56,450	50,000	60,500	55,820	61,000	60,800	59,000	59,000	61,500	63,000	59,300	64,500	62,000
Weight on trailing truck, lb.	53,000	57,500	51,000	49,970	56,650	52,700	60,500	51,000	57,700	59,500	55,000	61,000	57,500	60,500	59,500	56,600	65,000	63,000
Weight of tender, loaded, lb.	192,000	195,500	181,500	188,500	192,050	191,900	213,000	258,000	234,760	231,900	292,900	283,500	285,400	225,300	194,000	217,900	274,100	259,300
Tender, water capacity, gal.	10,000	10,000	10,000	9,000	10,000	10,000	12,000	12,000	11,700	12,500	14,000	15,000	16,000	12,000	10,000	12,075	14,000	15,100
Tender, fuel capacity, tons or gal.	16	16	15	17	16	16	16	5,000	17	16	6,000	21	18	4,000	16	17½	18	18
Wheel base, driving, ft. and in.	18—3	18—3	16—6	19—3	18—3	18—3	18—3	18—0	18—0	18—0	20—0	18—0	18—3	20—0	19—10	18—10	19—7	19—3
Wheel base, engine, ft. and in.	40—0	40—0	38—1	40—8	40—10	40—0	40—10	42—1	40—4	42—0	43—3	42—0	40—10	42—3	42—3	40—0½	42—2	41—4
Wheel base, engine and tender, ft. and in.	75—8½	75—8½	73—8	78—4¾	76—7	75—8½	76—6½	82—8½	77—7¼	80—7¼	84—0	84—7	83—11	83—6	79—3	79—3⅞	88—4½	89—0
Cylinders, diameter and stroke, in.	27x30	28x30	22½x30	27x28	27x30	27x30	27x30	28x30	28x28	27x30	27x30	27x30	27x30	28x30	28x28	27x30	27x30	30x30
Driving wheels, diameter, in.	69	69	62	72	69	69	69	69	69	69	73	69	69	73½	74	72	73	74
BOILER DATA																		
Steam pressure, lb.	200	200	240	200	200	200	200	210	200	225	215	225	265	210	200	250	250	210
Fuel	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Oil	Soft coal	Soft coal	Oil	Soft coal	Soft coal	Oil	Soft coal	Soft coal	Soft coal	Soft coal
Boiler, diameter, first ring, in.	78	86	74	78	78	78	76⅝	84¼	82	82 7/16	78	82 7/16	79⅝	82 7/16	80	84½	84	90
Firebox, length, in.	120⅛	114⅛	112⅛	114⅛	120⅛	120⅛	120⅛	120⅛	120⅛	120⅛	121⅜	120⅛	120	120	108⅛	125 13/16	126⅛	132¼
Firebox, width, in.	84¼	96¼	84¼	84¼	84¼	84¼	84¼	90¼	84¼	90¼	96¼	90¾	85	90	84	79⅞	96¼	96
Tubes, number and diameter, in.	216—2¼	247—2¼	208—2	190—2¼	190—2¼	190—2¼	184—2¼	226—2¼	209—2¼	40—2¼	175—2¼	40—2¼	33—3½	223—2¼	202—2¼	120—2¼	399—2¼	269—2¼
Flues, number and diameter, in.	40—5½	45—5½	38—5⅜	45—5½	45—5½	45—5½	45—5½	54—5½	48—5½	199—3½	43—5½	199—3½	172—3½	45—5½	48—5½	170—3½	50—5½	48—5½
Length over tube sheets, ft. and in.	20—6	20—6	20—0	21—0	20—6	20—6	20—0	22—0	21—0	20—6	20—6	20—6	19—8	21—6	22—5	19—1	22—0	23—0
Grate area, sq. ft.	70.3	76.3	65.6	66.7	71.1	70.3	70.3	75.3	70.3	75.3	80.3	75.3	70.8	75.7	63	69.9	84.3	89.17
Heating surface, firebox, total, sq. ft.	348	373	351	343	408	351	341	395	419	353	409	353	458	350	368	397	451	383
Heating surface, tubes and flues, sq. ft.	3,773	4,293	3,232	3,696	3,608	3,608	3,448	4,619	4,021	4,202	3,365	4,202	3,677	4,206	4,069	4,303	4,661	5,208
Heating surface, total evap., sq. ft.	4,121	4,666	3,583	4,039	4,016	3,959	3,789	5,014	4,440	4,555	3,774	4,555	4,135	4,556	4,437	4,700	5,112	5,591
Superheating surface, sq. ft.	966	1,085	932	1,118	1,145	1,078	1,103	1,477	1,180	1,931	1,032	1,931	1,758	1,162	1,327	1,632	1,352	1,305
Comb. evap. and super. surface, sq. ft.	5,087	5,751	4,515	5,157	5,161	5,037	4,892	6,491	5,620	6,486	4,806	6,486	5,893	5,718	5,764	6,332	6,464	6,896
PROPORTIONS AND RATIOS																		
Weight on drivers ÷ weight of engine, per cent	68.7	69.1	67.3	66.5	66.7	67.2	67.5	68.8	68.3	66.7	68.0	67.0	67.8	66.9	67.7	69.7	67.0	68.75
Weight on drivers ÷ tractive force	4.17	4.19	4.08	4.43	4.05	4.16	4.29	4.02	4.53	3.95	4.50	4.03	3.62	4.31	5.07	4.13	4.15	4.23
Weight of engine ÷ comb. h. s.	64.2	61.3	67.2	62.2	63.3	66.1	70.0	54.9	64.0	55.5	75.2	56.2	61.6	64.4	65.7	60.5	61.0	58.0
Firebox surface per cent evap. h. s.	8.45	8.00	9.78	8.49	10.20	8.86	9.00	7.88	9.45	7.75	10.85	7.75	11.09	7.68	8.30	8.27	8.82	6.86
Firebox surface ÷ grate area	4.95	4.90	5.35	5.14	5.74	5.00	4.85	5.25	5.96	4.68	5.10	4.68	6.48	4.62	5.84	5.67	5.35	4.30
Superheat. surface per cent comb. h. s.	19.0	18.9	26.0	21.6	22.2	21.4	22.6	22.8	21.0	29.8	21.5	29.8	29.8	20.3	23.0	25.8	20.9	23.5
Tractive force ÷ comb. h. s.	10.59	10.08	11.08	9.35	10.45	10.72	11.04	9.39	9.65	9.35	10.37	9.35	11.55	9.99	8.75	10.20	9.85	9.44
Tractive force × dia. drivers ÷ comb. h. s.	731	696	686	673	720	740	762	648	665	645	830	645	797	734	647	733	720	699
Comb. heat. surface ÷ grate area	72.4	75.4	68.7	77.5	72.6	71.6	69.6	86.2	80.0	86.1	59.8	86.2	83.2	75.6	91.5	90.6	76.6	77.4
Notes	b-c	b-c	a-d-g	b-c	b-c-d	b-c	a-g	a-d	b-c-d	a-g-k	b-c-d-e-g	a-e-g-k	a-e-f-k	a-g	a-d	b-c-f-k	a-d	....

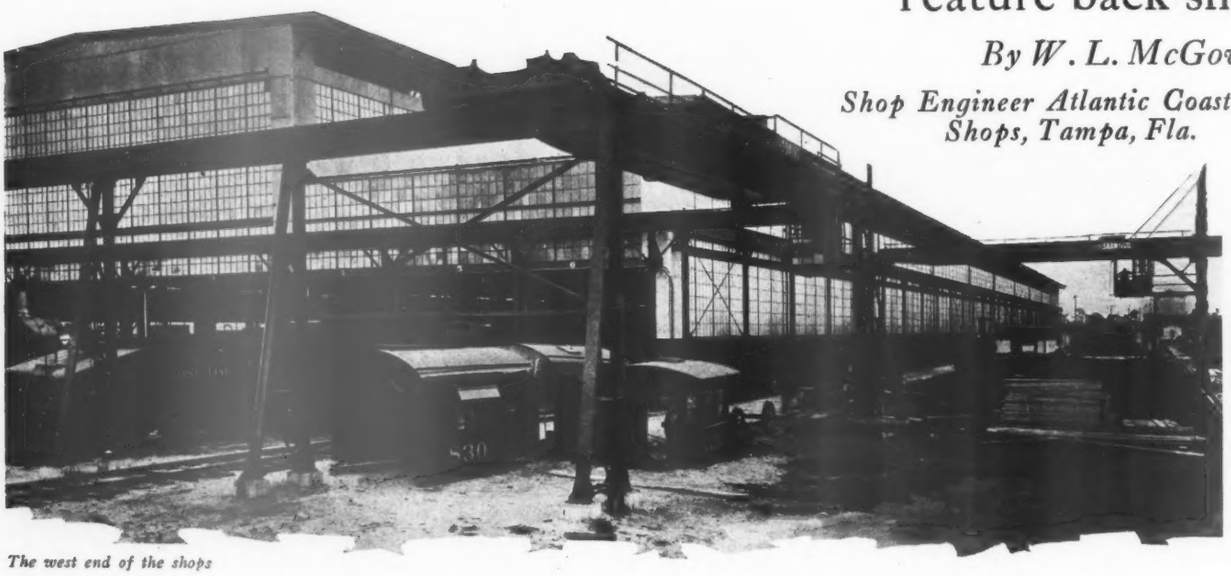
Key to notes:—a—Boiler diam., inside; b—Boiler diam., outside; c—Combustion chamber; d—Syphon; e—Feedwater heater; f—Limited cut-off; g—Booster or aux. loco.; k—Type E superheater.

How the Atlantic Coast Line Locomotives

Modern equipment and layout feature back shops

By W. L. McGowan

Shop Engineer Atlantic Coast Line Shops, Tampa, Fla.



The west end of the shops

ONE of the three principal locomotive repair shops of the Atlantic Coast Line is located at Tampa, Fla. This shop was placed in complete operation in 1927, and is considered to be one of the best equipped and most modern shops in the South. It is laid out with longitudinal tracks, and all the shop departments engaged in locomotive repair work are located in one building. Considerable study was made by the management to have all departments and operations located in a compact unit as far as possible, with the object of facilitating the routing of parts with speed and a minimum of handling.

The buildings are especially designed for semi-tropical climatic conditions. They are surrounded with numerous palms and other tropical plants native to this section of the country. The shops serve the entire third division of the Atlantic Coast Line System. This division includes all the lines south of Jacksonville, Fla., the majority of which were formerly a part of the "Plant System." Approximately 350 locomotives are used in the third division, the running repairs for which are handled in five engine terminals located at Jacksonville, Lakeland, Sanford, High Springs and Tampa. The engine terminal at Tampa, which is also shown on the layout drawing of the repair tracks and buildings, is a 22-stall layout, of which 12 stalls are pit tracks under roof.

In addition to making heavy repairs to all the locomotives used in the third division, the back shop at Tampa furnishes stores materials to the various outlying repair points, makes repairs to roadway and bridge equipment, and maintains a number of phosphate elevators which have a total capacity of approximately 600 tons per hour.

It is said, that about 85 per cent of the world's supply of phosphate rock is mined in Florida. A large proportion of this traffic is handled over the lines of the third division. All phosphate cars are sent to Tampa for heavy repairs. In fact, the car shops at this particular point make repairs to comparatively few cars that are not used for transporting phosphate. The freight-car shop, in which this work is handled, is 500 ft. long and covers two repairs tracks, placed 19 ft. apart, center-to-center. Ample track space is also provided outside the building for handling considerable repair work in peak times. Cars are repaired in this shop by what is generally known as the station-to-station or spot system.

Layout of the Shops—Longitudinal Tracks in Erecting Bay

The executive offices for the third division are located within close proximity to the main shop, engine-house, and car department. In the office building are the offices of the superintendent of motive power and his staff, the shop superintendent and staff, the division storekeeper and staff, and the road foreman of engines.

In addition to the main office building, there is a fire-proof wash and locker building, which is located east of the main shop. It is equipped with Bradley

Coast Line Repairs at Tampa

designed for semi-tropical conditions

located at Tampa

Part I

The east end of the shops

wash fountains, shower baths, and steel lockers, sufficient to take care of 1,800 employees.

The entire shop and premises, as well as the transportation yards, are provided with private automatic exchange telephones. This is a dial system telephone, and has code call equipment. The code call system as it is installed at Tampa, is a unique feature in the administration of the shops, and is a valuable adjunct to the shop communication system. For example, if the shop superintendent wishes to talk to the general foreman, he dials the general foreman's office number. If the general foreman is not in his office, but is out somewhere in the shop, he dials the general foreman's code number. This code number is signalled throughout the shops and premises by means of air whistles, and by green signal lights. Recognizing his code call, the general foreman goes to the nearest telephone, and is placed in communication with the shop superintendent. The green signal lights are used in those sections of the shop where the whistles can not be heard easily. Code calls are assigned to all the department heads and executive mechanical officers, and to the general yardmaster and yardmasters. The main switchboard is equipped for 60 telephones with code calls.

The main building is of steel construction 638 ft. long by 265 ft. wide. As shown in several of the illustrations, the sides and ends are enclosed with steel sash. This side-wall construction begins at a point 8 ft. above the floor level. The remaining portion of the wall structure is made of corrugated asbestos siding. No provision is made for closing the 8 ft. opening at the floor level around the building. The roof is constructed, as shown in several of the illustrations, with wide overhanging eaves which afford protection against rain entering wide openings in the wall directly underneath. These openings underneath the eaves and at the floor level afford free circulation of large quantities of air through the interior of the building at all times. This method of air circulation is quite effective in this climate, and keeps the interior from 15 to 20 deg. cooler than the outside atmosphere. The roof construction, known as the Aiken type, is of wood covered with Johns-Manville built-up roofing. The floor is made of treated wood blocks set on a concrete base.

Equipment for Handling Material

The main shop building is provided with 10 traveling electric cranes of various capacities. The material-storage yards which are located on each side of the shop are each served by 10-ton half-gantry cranes, while the yard at the end of the shop is served by a 10-ton bridge crane. The erecting bay is 90 ft. wide and has three longitudinal tracks spaced 30 ft. center to center. This bay is served by two 100-ton bridge cranes and four 3-ton traveling wall cranes, which are equipped to be operated either from the floor or a cab mounted on the crane.

The heavy machine-shop bay has a width of 75 ft. and is served by two 10-ton traveling bridge cranes.

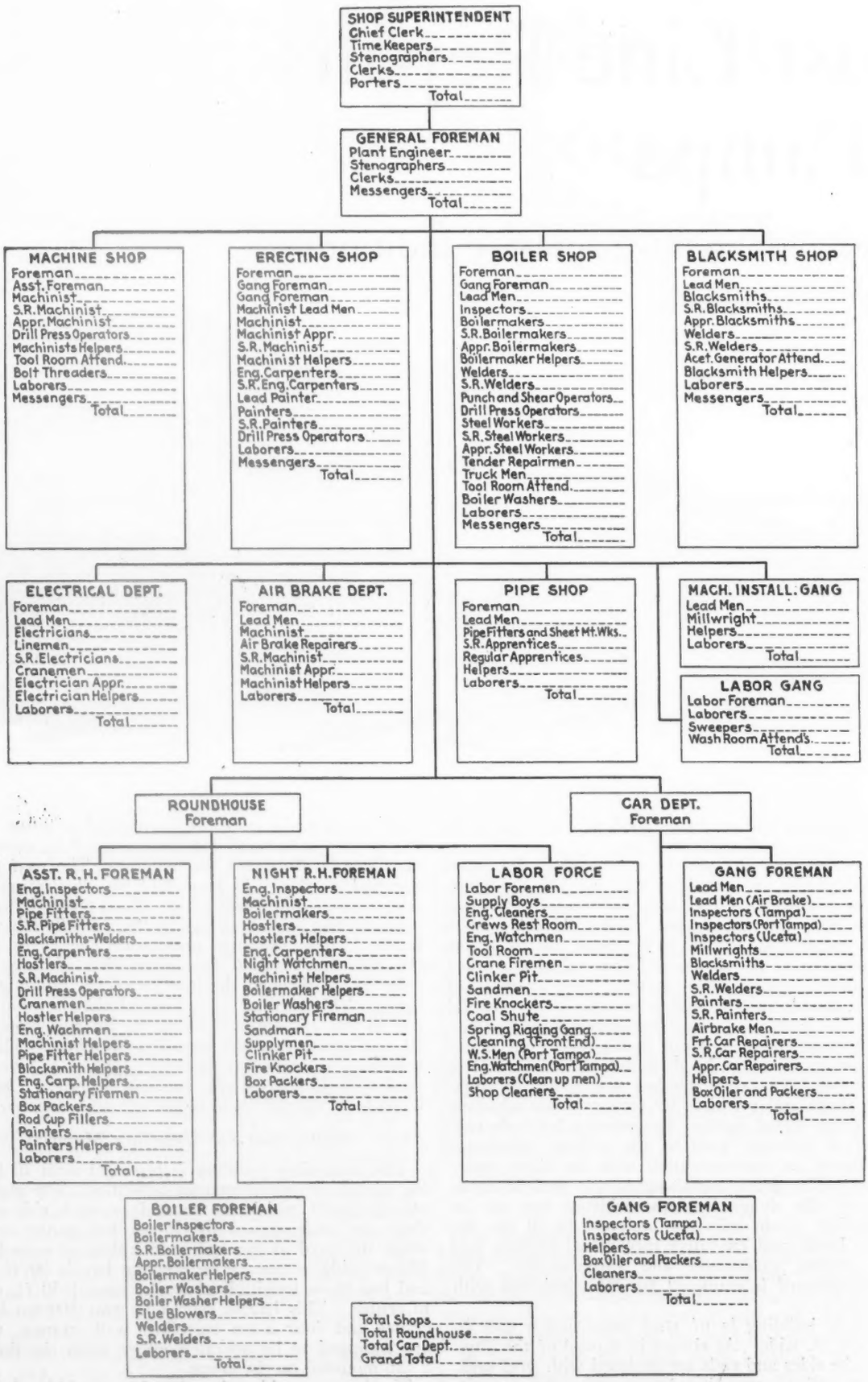


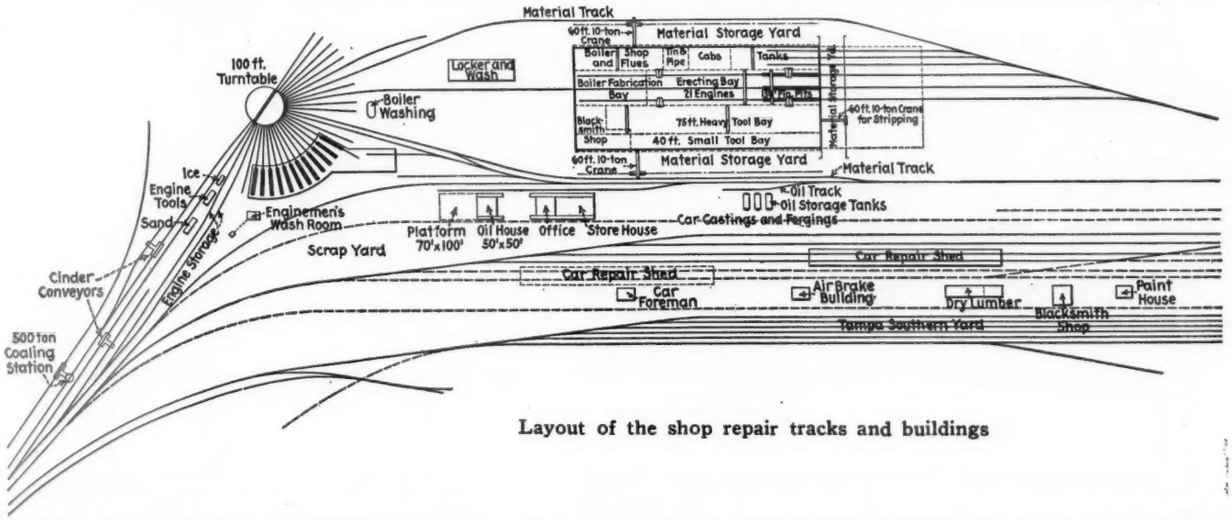
Fig. 1—Chart showing the departmental organization of the Atlantic Coast Line shops, Tampa, Fla.

The boiler and tank shop, which is 60 ft. wide, is served by two 15-ton bridge cranes. A considerable number of small jib cranes equipped with Shepard electric hoists ranging from one-half ton to two tons capacity are strategically located in the light and heavy machine bays. Sufficient space has been allowed in both of these bays for the installation of additional machine tools and equipment.

The design of the main shop building is such that additional balconies and crane service can be installed which will enable the shop to handle a 25 per cent increase in production. At the present time, this shop can handle an output of from 40 to 50 locomotives per month, including heavy repairs of all classes. In the layout of these shops, the management made a careful study of all the exigencies relative to future expansion should operating conditions require an increase in shop production. Ample floor space is provided for the installation of 25 per cent additional machine tools and equipment, and sufficient land has been allowed around the building so that the floor area of the present structure may be increased 60 per cent if necessary.

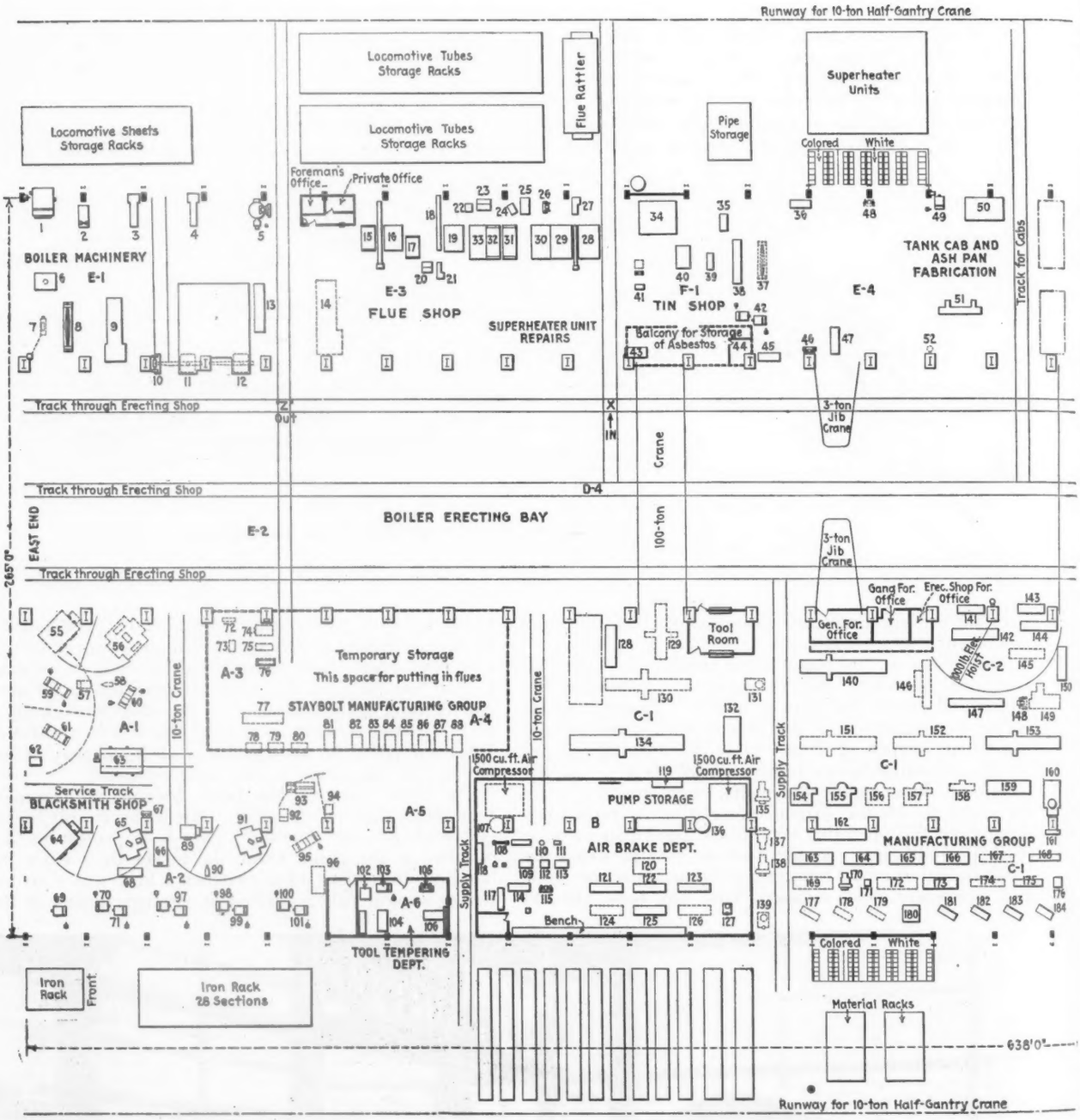
Electric power is purchased from the local power company, and is delivered to a sub-station at 4,000 volts, 3 phase, 60 cycles, a. c., where it is transformed to 440 volts, a. c., for power requirements and to 110 and 220 volts, for lighting purposes. The lighting system is controlled from distributing boards located on columns in different parts of the shop. In addition to the general lighting system used when the shop is working, a night lighting circuit is installed which is controlled from one panel, so arranged that all lights may be cut out except those used in the night circuit.

The power system has been designed to eliminate fuse plugs wherever possible. Air-break circuit breakers, with inverse time-limit over-load protection, are installed at the point where the power lines enter the building, instead of fuse switches. Power is distributed to several panels located at strategic points in the



Layout of the shop repair tracks and buildings

Part of the heavy machine bay—One of the balconies with starters and electric control equipment is shown in the background



Layout of machine tools and shop

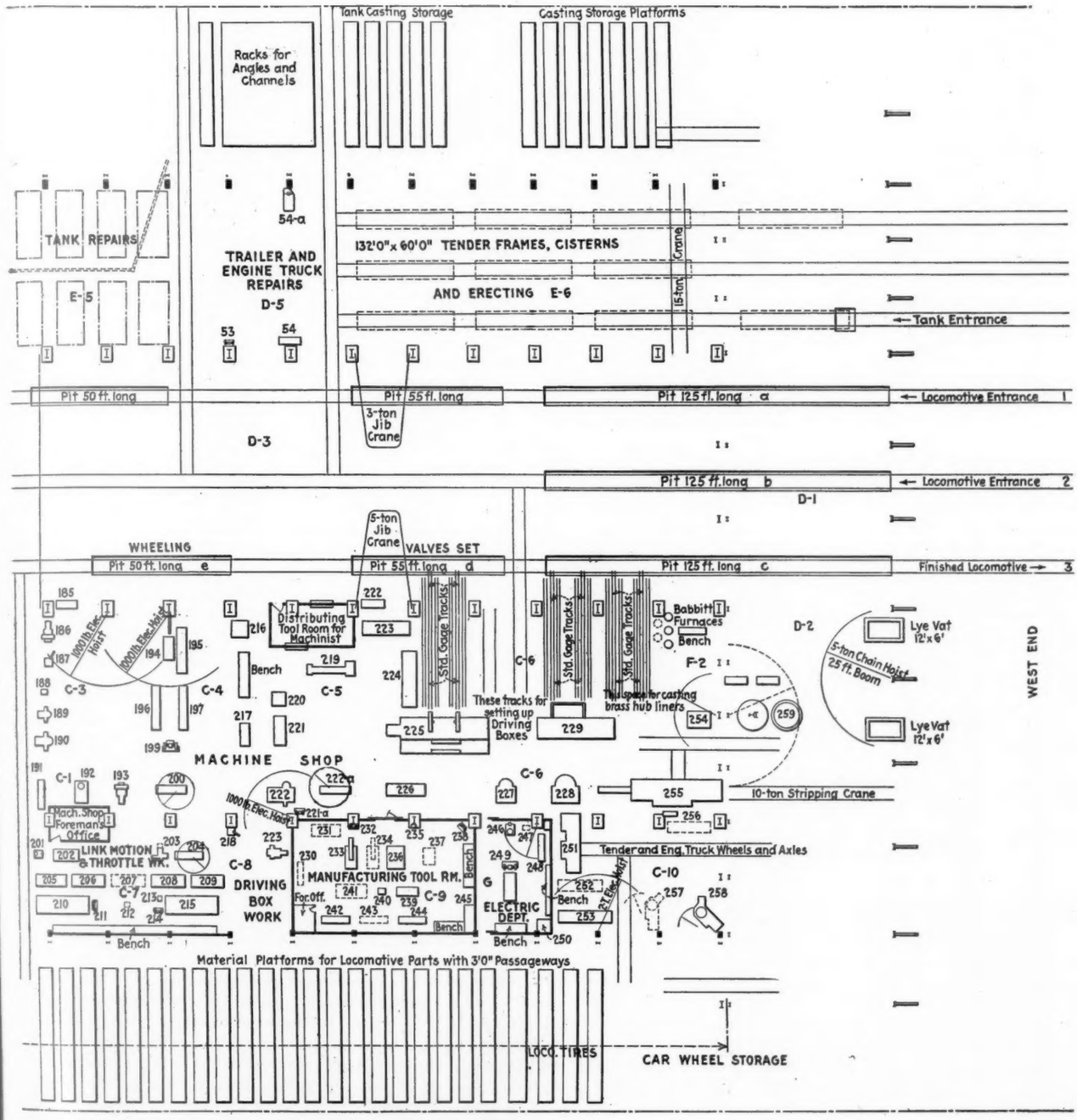
BOILER AND FLUE SHOP—GROUP E

Mach. or Equip. No.	Size	Kind
1	.....	Annealing plate furnace
2	¾ in.	Flanger
3	54 in.	Punch
4	54 in.	Single end shears
5	1¼ in.	Horizontal punch
6	.....	Face plate
7	.....	Flange furnace
8	12 ft.	Pneumatic clamp
9	.....	Bending rolls
10	24 in. by 3½ in.....	Double emery tool grinder
11	9 ft.	Radial drill
12	9 ft.	Radial drill
13	.....	Bench for mud ring fits
14	14 ft.	Bending rolls *
15 and 17	5 ft. by 9 ft.....	Crescent shape rack
16	7 ft. by 9 ft.....	Inclined rack (Flue tester on left)
18	.....	Bench for cutting flue to length
19	7 ft. by 9 ft.....	Inclined rack
20	.....	Flue annealing furnace
21	.....	Flue cutter
22	.....	Pneumatic flue swedger
23	.....	Swedging furnace
24	.....	Pneumatic flue welder
25	.....	Electric flue welder
26	18 in. by 3 in.....	Double emery tool grinder
27	.....	Flue cutter
28 and 29	.....	Inclined flue racks
30 and 33	.....	Flat tables
31 and 32	5 ft. by 12 ft.....	Crescent shape racks
34	150 cu. ft.	Air compressor
36	72-in. gap	Power squaring shears
46	24 in. by 3½ in.	Double emery tool grinder
47	48 in.	Rotary shear
48	18 in. by 3 in.....	Double emery tool grinder
49	.....	Single forge
50	14 ft. by 7 ft.....	Layout table
51	.....	Punch and shears
52	.....	Sensitive drill *

PIPE, TIN AND BRASS SHOPS—GROUP F

35	1 in. to 4 in.....	Pipe fitting machine
37	.....	Pneumatic clamp *
38	5 ft. by 16 ft.....	Bench
39	72 in.	Bending brake (Hand power)
40	5 ft. by 8 ft.....	Table

* Future installations.



equipment in the Atlantic Coast Line Shops, Tampa, Fla.

Mach. or Equip. No.	Size	Kind
41	.....	Pipe bender (Small forge adjacent)*
42	.....	Double forge
43	4 ft. by 8 ft.....	Acetylene brazer's bench
44	.....	Pipe and tin shop foreman's office
254	.....	Brass furnace
	ERECTING SHOP—GROUP D	
53	18 in. by 3 in.....	Double emery tool grinder
45, 54 and 185	14 in by 6 in.....	Portable engine lathe
54–a	6 ft.	Radial drill
259	.....	Tire heater
	BLACKSMITH SHOP—GROUP A	
55	9 ft. by 7 ft.....	Furnace
56	.....	Double frame steam hammer*
57	.....	Single forge *
58	.....	Large anvil *
59, 60 and 61	.....	Double forges *
62	.....	High speed power hack saw
63	.....	Rod annealing furnace
64	7 ft. by 9 ft.....	Furnace
65	2,000 lb.	Single frame steam hammer
66	300 lb.	Helve hammer
67	18 in. by 3 in.....	Double emery tool grinder
68	9 ft. by 3 ft.....	Face plate
69, 70, 71, 97, 98, 99, 100 and 101	.....	Oil burning forges with individual blowers
89	3 ft. by 4 ft.....	Furnace
90	.....	Large anvil
91	1,500 lb.....	Single power steam hammer
92	.....	Single forge *
93	.....	Stock adjusting machine *
94	.....	Pump *
95	.....	Double forge *

* Future installations.

AIR BRAKE DEPARTMENT—GROUP B

Mach. or Equip. No.	Size	Kind
96	300 lb.	Power hammer *
72		Stripper *
73		Bander *
74		Furnace *
75		Face plate *
76		Tempering bath *
77		Storage bin for staybolts *
78 and 79	4-spindle	Drill for tell-tale holes *
80	3-head	Staybolt threading machine *
81	350 lb.	Helve hammer *
82		Furnace for 4-in. forging machine*
83	4 in.	Forging machine *
84		Furnace for 2-in. forging machine
85	2 in.	Forging machine *
86		Furnace for 1½-in. forging machine *
87	1½ in.	Forging machine *
88		Extra standby furnace

AIR BRAKE DEPARTMENT—GROUP B

107	54-in.	Air reservoir
108	2½ ft. by 3 ft.	Bench
109		Engine valve test rack
110		Lapping machine *
111		Bench with lathe on stand
112		Distributing valve test rack
113		Triple valve test rack
114		Bench for power reverse gear repairs
115		Double emery tool grinder
116	15 in. by 3 in.	Sensitive drill
117 and 118		Stock bins
119		Test rack for air compressors
120		Special grinder *
121, 122 and 123		Stock racks
124	24 in. by 5½ ft.	Engine lathe *
125	20 in. by 6 ft.	Engine lathe with taper attachment
126	20 in. by 5¼ ft.	Engine lathe *
127	32 in.	Drill
136	54 in.	Air receiver

MACHINE SHOP—GROUP C

128	5 ft. by 16 ft.	Layout table
129	42 in. by 42 in. by 10 ft.	Planer *
130	42 in. by 42 in. by 15 ft.	Planer *
131		Vertical miller *
132	7½ in.	Turret lathe
134	60 in. by 54 in. by 20 ft.	Planer
135, 137 and 138	36 in.	Drills *
139	34 in.	Drill *
140	48 in. by 48 in. by 14 ft.	Slab miller
141 and 143	2½ ft. by 10 ft.	Benches
142 and 145	36 in. by 7 ft.	Engine lathes
144	30 in. by 7 ft.	Engine lathe
146		Gap piston rod grinder *
147	18 ft. by 3 ft.	Bench
148	18 in. by 3 in.	Double emery tool grinder *
149	6 ft.	Radial drill *
150	24 in. by 5 ft.	Engine lathe with taper attachment
151	36 in. by 36 in. by 14 ft.	Slab miller *
152 and 153	36 in. by 36 in. by 14 ft.	Planers *
154	44 in.	Boring mill
155	43 in.	Boring mill
156	42 in.	Boring mill *
157	36 in.	Boring mill *
158		Guide bar grinder *
159	24 in. by 45½ in.	Horizontal boring mill
160	6 ft.	Radial drill
161		Bolt centerer
162	24 in. by 11 ft.	Engine lathe
163	24 in. by 7 ft.	Engine lathe
164	18 in. by 6 ft.	Engine lathe
165	20 in. by 6 ft.	Engine lathe
166	18 in. by 6 ft.	Engine lathe
167 and 174	20 in.	Brass lathes *
168 and 175	20 in.	Brass lathes
169 and 172	24 in. by 7 ft.	Engine lathes *
170	36 in.	Heavy duty drill
171	15 in. by 13 in.	Sensitive drill
173	24 in. by 5½ ft.	Engine lathes
176	13 in. by 16 in.	Power hack saw
177	3 in.	Turret lathe *
178 and 179	2¼ in.	Turret lathes *
180	1½ in.	Bolt cutter
181	2¼ in.	Turret lathe
182, 183 and 184	3 in.	Turret lathes
186	36 in. by 26 in.	Vertical drill
187	100-ton	Hydraulic press
188	13 in. by 16 in.	Sensitive drill
189	24 in.	Boring mill
190	36 in.	Boring mill
191 and 204	30 in.	Draw cut shaper
192	18 in.	Slotter
193	36 in.	Heavy duty drill
194	14 in. by 2 in.	Rod polishing machine
195 and 197	4 ft. by 16 ft.	Main rod benches
196	4 ft. by 16 ft.	Side rod bench
199	24 in. by 3½ in.	Double emery tool grinder
200	36 in.	Draw cut shaper
201	32 in.	Drill press
202	28 in.	Shaper
203		Combination link and internal grinder
205, 208 and 209	18 in. by 6 ft.	Engine lathes with taper attachment
206 and 207	20 in. by 6 ft.	Engine lathes
210 and 215	5 ft. by 18 ft.	Stock tables
211	18 in. by 3 in.	Double emery tool grinder
212	50-ton	Hydraulic press
213		Sensitive drill
214	3 in. by 1 in.	Double spool emery grinder
216	2 in.	Triple head bolt cutter
217	14 in. by 2½ ft.	Portable engine lathe
218	100-ton	Hydraulic press
219	800-ton	Wheel press
220	13 in. by 16 in.	Hack saw
221	28 in.	Crank shaper
221–a	18 in. by 3 in.	Double emery tool grinder
222	42 in.	Boring mill for driving boxes
222–a	36 in.	Draw cut shaper
223	36 in. by 26 in.	Drill press
222	14 in. by 2½ ft.	Portable engine lathe (Located near tool room)
223	36 in. by 7 ft.	Engine lathe (Located near tool room)
224	36 in. by 10 ft.	Engine lathe
225	90 in.	Wheel lathe
226	24 in. by 7 ft.	Engine lathe
227	54 in.	Boring mill
228	100 in.	Boring mill
229	90 in.	Journal, quartering, hub facing and crank pin turning machine
230	24 in. by 5¼ ft.	Lathe *
231	36 in. by 8 in.	Reamer grinder
232	14 in. by 2 in.	Double emery tool grinder
233	24 in.	Crank shaper
234	26 in.	Crank shaper *
235		Tool grinder
236		Knee-type milling machine
237		Knee-type milling machine *
238	18 in. by 3 in.	Double emery tool grinder
239	12 in. by 42 in.	Universal grinder
240	15 in. by 13 in.	Sensitive drill
241		Plain surface grinder *
242	20 in. by 6 ft.	Lathe with taper attachment
243	20 in. by 5½ ft.	Tool room lathe
244	16 in. by 5 ft.	Engine lathe with taper attachment
245		Pneumatic tool repair bench
246	32 in.	Drill
247	15 in. by 13 in.	Sensitive drill *
248	20 in. by 6 ft.	Engine lathe
249	18 in. by 3 in.	Double emery tool grinder
250		Generator test rack
251	600 ton	Wheel press
252		Car axle lathe *
253		Combination journal and axle lathe
255	42 in.	Car wheel lathe
256		Car axle lathe *
257	52 in.	Car wheel boring *
258	52 in.	Car wheel borer

* Future installations.

shop. Additional air-break circuit breakers are located at the panels, which serve as centers of distribution of the power to the various motors in the adjacent locality. The power current passes through the circuit breakers to bus bars, through which it is carried to switches and remote control across-the-line starters. These switches and starters are secured to panels, which are located on a narrow gallery placed along the row of columns between the light and heavy machine bays. Several of these galleries are shown in the illustrations. This arrangement saves floor space, and requires only the installation of push-button control at each machine.

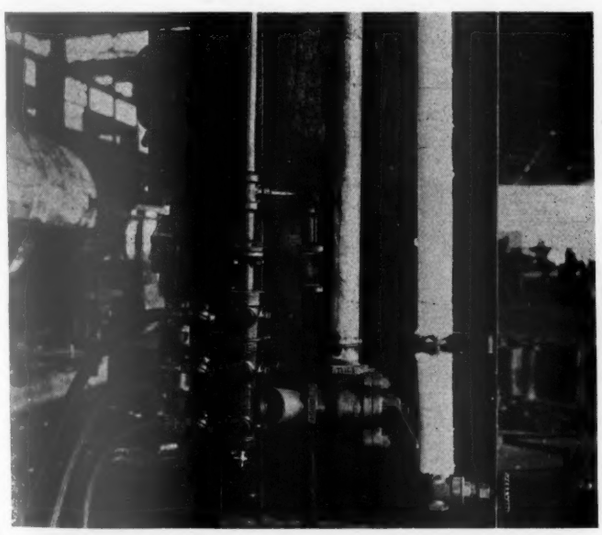
All of the machine tools in the shop are equipped for individual motor drive, and each machine has its remote starting equipment on the panel in the nearest gallery. Each starter equipment in the gallery is marked with the number of the machine it serves. This facilitates making repairs to the electrical equipment. In case of a short circuit or electric breakdown, only the circuit to the machine is affected, and any possibility of the entire shop or a whole department being shut down due to accidents of this kind is eliminated.

Two 1,500 cu. ft. electrically driven air compressors supply air for the shop at 90 lb. pressure, and space has been reserved for the future installation of an additional unit. The shop is piped for the distribution of

compressed air, steam, oxyacetylene and for service and drinking water. Special pains were taken in laying out the piping so as not to detract from the general interior appearance of the shop. Electric power and lighting outlets are placed on columns in convenient locations, and at service stations on the floor between the erecting shop longitudinal tracks. Overhead R. L. M. type reflectors are used for the general illumination of the shop, and the lights are so arranged as practically to eliminate shadows.

The blacksmith shop is equipped with oil-burning forges and furnaces, having individual motors and blowers, which practically eliminate smoke and soot from the shop. Electric pyrometers are installed on furnaces which are used in connection with the heat treatment of steel. At the present time all of the machine forgings are shipped to Tampa from other back shops on the system. The floor space intended for forging production is now used by the stores department for the storage of forgings and other material. This, however, has been found to have its advantages as it places the stores department under the same roof, and expedites the delivery of material to various points in the shop.

Considerable stress is laid on orderliness and cleanliness by the shop management. Each cutting tool is stamped with the number of the machine on which it is used. This saves considerable time in making tool replacements, and facilitates the issuing and handling of tools from the tool room in an orderly manner. In addition to the number, each machine shows the name of the operator, which is stamped on a metal strip, 10 in. by 1½ in., which is attached to the machine. This tends to create the pride of ownership on the part of the operator in the machine which he operates, and the scheme has been found to be helpful when making inspections for cleanliness. It is generally agreed



Outlet connections for oxyacetylene, compressed air and steam

among the shop supervisors and mechanical department officers that the record of no reportable accidents during 1928, when the shops employed on an average of over 400 men, was due to the stress laid on cleanliness and orderliness in the shops.

An open thoroughfare, 8 ft. wide, extends the full length of the shop and through the heavy machine bay. Other aisles branching off to areas known as parking spaces or material reservoirs, have been laid out at frequent intervals. Departments are also connected by 8 ft. aisles.

In the rear of each machine operator is sufficient space for the parking of necessary materials. These spaces were laid out in much the same manner as the aisles, and are placed in close proximity to them. The borders of the aisles and parking spaces are marked with strips of sheet metal cut 3 in. wide and nailed down to the floor.

With this arrangement, all materials and work are kept in their allotted confines, which are limited, thereby reducing to a minimum the amount of stock and scrap which can be kept around machines. Each machine also, has a double-deck steel table 30 in. high, which can be easily reached from the operator's side of the machine. The table is of a length and width sufficient to hold the usual type of clamps and clamp bolts, and is provided with a small locked drawer for storing precision and other valuable tools.

The Methods of Supervision

On the layout drawing it will be noted that the various departments are divided into groups, each of which has a specific function. This layout and the various

ORGANIZATION CHART TAMPA SHOPS

Department	Actual			Correction			Totals		Theoretical Total		
	Mechanics	Helpers	Laborers	Mechanics	Helpers	Laborers	Actual	Correction	Production Rate	Percent	
Machine Shop											
Erecting Shop											
Boiler Shop											
Blacksmith Shop											
Electric Dept.											
Air Brake Dept.											
Pipe Shop											
Crane Operators											
Instalation Gang											
Sweepers and Cleaners											
Official											
Supervisors											
Clerical											
Executive											
Total											

Fig. 2—Consolidated report showing the employment requirements

systems in practice at these shops permits easy supervision and reduces to a minimum the amount of supervision necessary per locomotive turned out.

The chart, Fig. 1, shows at a glance the amount of supervision necessary for an output of 25 locomotives per month. The chart is filled in each month for the information and guidance of the shop superintendent, and it enables him to keep in contact with the general employment condition. Fig. 2 is a sample of the consolidated report, which is the first page from the organization record book kept by the shop engineer for the information of the general foreman. The first column lists the different departments in the organization. The remaining columns show the number of men in various grades employed in each department at the time the report is submitted. There is also a column which shows the theoretical number of men necessary for the efficient operation of each department. The second column under the theoretical total shows the total number of men required in per cent, and the first shows the total required per production rate or unit. Corrections are determined from these two factors, and also by considering existing conditions.

A production unit, as defined during the first 18 months of operation in the new shops, is considered as the equivalent of a Class 5 repair. If a locomotive comes into the shop for Class 5 repairs which requires new flues or flues replaced, it is assigned a Class 5-F repair, and is allowed 1½ production units. Other

class repairs are subdivided to suit requirements, and are assigned fractional production units according to the amount of work performed. A Class 4 repair is the equivalent of three production units, a Class 3 is assigned four production units; Class 2 has six, and Class 1, five. A new basis for estimating the production unit is now being developed.

To ascertain the labor cost per unit of production over a given period, it is only necessary to divide the total labor cost for the period by the sum of the production units accumulated during the same period.

Rule-of-thumb methods are replaced by this method, and a true balance of labor may be determined for any given amount of production.

An interesting chart record is kept by the shop engineer under the general heading "Graphical Analysis of Production." Some of these charts are shown in Figs. 3 to 6, inclusive. Production units have been determined from data accumulated over a period of several years, which affords a means of comparison with previous performance.

A daily cost sheet is kept by the general foreman, copies of which are sent to the shop superintendent and to each department foreman each day. Thus, the department foremen are in constant touch with their expenditures, and may curtail work not of absolute necessity, thereby not exceeding their budget.

The erecting shop—Regulations pertaining to orderliness and cleanliness are strictly enforced

In this shop, the unit system of grouping machines and bench jobs is used throughout. Machines, forges, and furnaces are numbered consecutively, and by types; the lathes in one group, shapers in another, etc. The various departments are divided into groups, each having a specific function. For example, the blacksmith shop is composed of six groups: *A-1,* heavy forging group; *A-2,* the light forgings; *A-3,* springs; *A-4,* staybolts, miscellaneous machine forging and threading; *A-5,* electric and acetylene welding, and *A-6,* tool tempering and forging.

All of the groups with the designation *A,* are under the supervision of the blacksmith foreman. The letter *B* designates those groups under the supervision of the air-brake foreman. The letter *C* designates those groups under the supervision of the machine shop foreman and his assistant.

The manufacturing group *C-1,* takes in all new work, semi-finishing and finishing for stock and other shop orders, and such other work as may lap over from the other groups of this department. The group *C-2* is laid out with ample floor space and machines to take care of all pistons and rods, crossheads, rocker boxes and arms, valves and appurtenances. Groups *C-3* and *C-4,* are equipped and have ample floor space for handling all side and main rod work. All driving wheels and crank pins are removed and applied in group *C-5,* which is equipped with an axle lathe, two engine lathes and has the use of the rod-bench shaper for fitting keys. The key ways are milled by the manufacturing group *C-1.* Group *C-6* is arranged and equipped for boring tires and machining wheel centers, turning wheels and journals, facing hub plates, fitting driving boxes, and turning crank pins with portable machines. Grease cellars are also packed and boxes applied to journals in this group.

Group *C-7* indicates the link and throttle lever group. Benches and machines are grouped so that a minimum of labor and movement of parts and materials are required. In group *C-8* all driving boxes are stripped of the crown bearing, new bearings are fitted and pressed in, dowel holes drilled and dowels fitted, shoe and wedge fits planed and brought back to standard, crown bearings bored, boxes faced, and cellars fitted. All this work is performed within a circle of 20-ft radius. This entire group is served by a jib crane equipped with a Shepard electric monorail hoist. The tool-manufacturing group is shown as *C-9.* This group is enclosed by an expanded metal partition. The car-wheel group, *C-10,* has not as yet been placed in complete operation, but will be as soon as proper track facilities for storage have been installed.

All sections marked *D* are under the supervision of the erecting shop foreman, who is assisted by two gang foremen. Tracks 1, 2, and 3 enter section *D-1,* and

extend the full length of the erecting shop. The arrangement of pits is shown on the drawing. The first pits extend half their length outside of the erecting shop, and are used as stripping pits. They are served by a 60-ft. span 10-ton overhead crane. Both stripping and unwheeling, and the finishing and wheeling are performed in this section. Section *D-2* is located immediately outside of the building, and is provided with a concrete floor. All tires are removed and applied here, and the wheels are counterbalanced. The lye vats are also placed in this section, and are of such size that a completely assembled engine truck may be cleaned without removing any of its parts.

Section *D-3* is the main erecting section, where all engines are placed within marked parking spaces. The tail bar of the engine is lined up with a marker which is nailed to the floor. In this manner thoroughfares are kept open and the shop presents a neat appearance at all times. A marked material reservoir, 10 ft. by 20 ft. is located beside each locomotive parking space where parts are placed until applied. Section *D-4* is the frame erecting section. Here are placed all engines receiving new frames, new boilers or extensive boiler or frame repairs. All engine and trailer trucks are repaired in section *D-5*.

All groups marked *E* are under the supervision of the boiler-shop foreman, one assistant foreman, one lead man and an inspector. Group *E-1* is the manufacturing group of the boiler shop. It is here that all the trimming, shaping, forming, punching, and drilling is done before it is delivered to other groups in the boiler shop. All boilers removed from the frames are placed in group *E-2*. The flue shop is a complete plant, and is designated as group *E-3*. Flues enter on the track marked X and are routed from the flue rattler, through the other operations in the group and out again on track *Z*. Cabs, and ash pans are fabricated in group *E-4*, and tanks, tender frames and trucks are fabricated and repaired in groups *E-5* and *E-6*.

Pipe and Sheet Metal Shops Under One Foreman

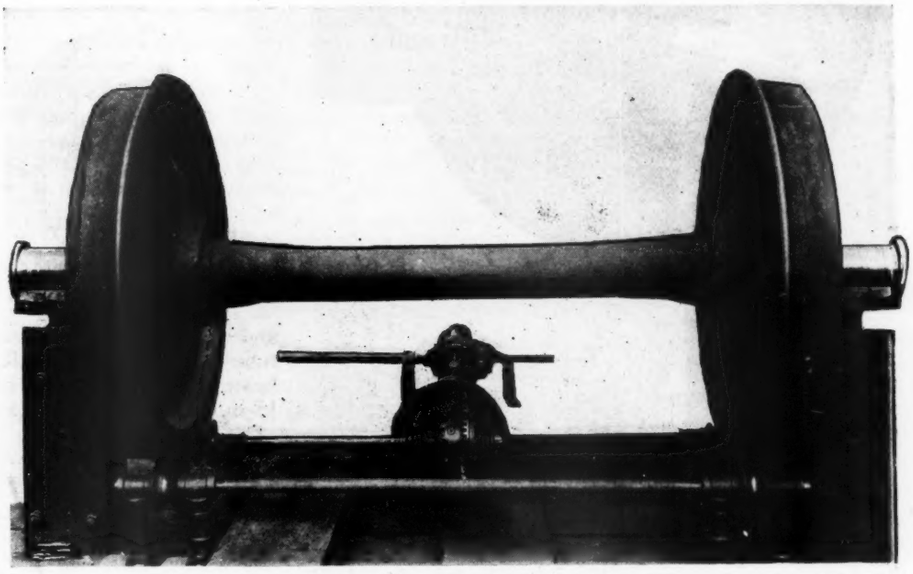
Groups marked *F* come under the supervision of the pipe-shop foreman, who also has supervision over the sheet-metal work. Group *F-1* is the main pipe and tin shop where all fitting, forming, brazing, and cutting is done. Group *F-2* is the metal pouring section. The babbitting bench and equipment are located here. The brass furnace is also located in this group and ample floor space is provided for brass pouring.

[Part II, which includes a description of the scheme of supervision, methods of handling the work and forms for controlling it, will appear in the January issue.—EDITOR.]

Device for Wearing-in Journal Bearings

AN efficient device for wearing-in journal brasses to secure the proper bearing on the journals has been devised by a large railroad and has proved a valuable aid in reducing hot boxes on passenger cars especially when the wheels are applied to equipment assigned to high-speed train service when it is not possible to run the car on a trial trip or break it in on branch or local runs.

The pair of wheels is mounted on two supports, each fitted with a spring to support the journal bearing and is allowed to revolve for from 30 to 45 minutes. This will indicate whether or not the brass has been properly fitted to the journal. The spring allows some flexibility of movement and permits the bearing to adjust itself to the journal. The wheel may be rotated by means of air, electric or hand power. One such device, in service at a passenger terminal on an eastern railroad, propelled by an ordinary air motor and connected by means of bevel gears and sheave wheels to the car-wheel flanges, has been in service for several months, and 75 pairs of wheels so treated have been applied to all classes of passenger equipment, such as baggage, express, dining, parlor and sleeping cars used on high-speed through trains. Trial trips and rider protection have not been found necessary.



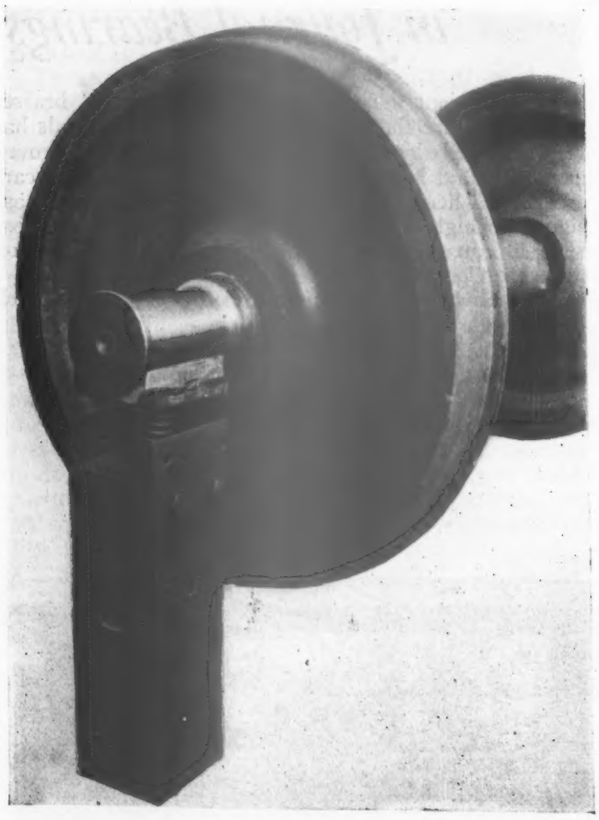
Device for wearing-in car journals showing one form of drive

Wheels can be placed on the device and have the brasses worn in, then stored on wheel tracks, with the bearings tied to the journal so as to have a sufficient number of wheels available for emergency use.

No matter how carefully journals may have been turned on a wheel lathe, they still require polishing before being applied to the car. This is usually taken care of by the mechanic applying the wheels to the car or tender, who first polishes the journal with a piece of canvas or cotton-duck wrapped around the journal.

By applying a piece of canvas or cotton duck on the top of the journal bearing on the above device and

saturating it with carbon oil the polishing can be accomplished before wearing-in the brass to the journal. The polishing cloth can easily be removed by pulling in



A close-up view of the journal brass and the spring mounting

the direction of rotation of the journal while the wheel is rotating. Then car or valve oil may be applied to the journal before the wearing-in operation is begun.

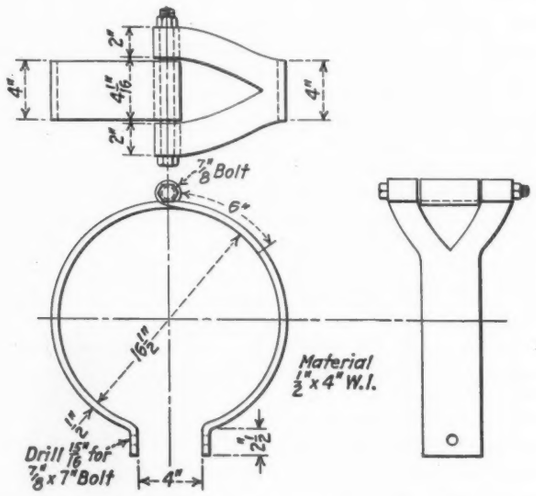
Clamp for Handling Elesco Heater Tubes

THE clamp shown in the sketch is used in an enginehouse on an eastern road for removing and applying bundles of tubes in Elesco feedwater heaters. It is, of course, practicable to use a chain or rope sling, but the heater must be evenly balanced in the sling and also anchored with an additional chain or rope extending from the hook to the outer end of the heater. A support of that type, however, is considered to be unsafe by the shop management.

This clamp was made in the blacksmith shop from 4-in. by ½-in. bar iron and has proved to be safe and satisfactory in service. A lighter piece of bar iron may be used, if desired.

To use the clamp the tube bundle is pulled about halfway out of the heater body, and the hinged clamp is placed around the tube-nest guards, with the open end of the clamp at the top of the bundle. The clamp is then secured by means of a 7/8-in. bolt, which is inserted through the 15/16-in. holes in the ends of the clamp.

The center line of the clamp should be located about 2 ft. from the inside face of the flange joint which fits against the end of the heater on the following types: H-5, K-39, K-39-A, K-24, K-31, K-31-A, K-31-C, K-54

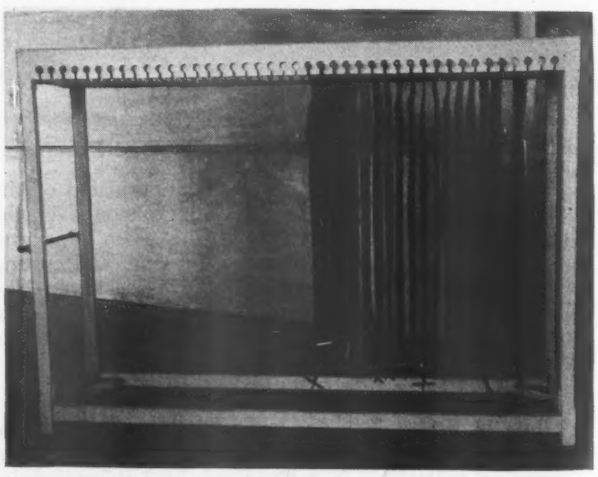


A safe and convenient clamp for removing tube bundles from Elesco feedwater heaters

and K-54-A. This will assure a good balance for the tube bundle. On the K-24-B and K-39-B types of heaters the center line of the clamp should be about 15-in. from the inside face of the flange joint.

Rack for Drying Coach Curtains

WHEN passenger-car window curtains have been washed, they must be hung perpendicularly so that they will dry properly. The frame of the drying rack shown in the illustration is made of 2-in. by 4-in. lumber, except for the two side strips at the top which are made of 2-in. by 6-in. material. The rack is mounted



Portable rack which holds 32 coach curtains for drying

on casters and is 8 ft. long and about 30 in. wide. Near the lower edge of each of the top side strips a row of 1-in. holes are bored to receive the ends of the curtain rods. The curtain passed through a slot leading from the bottom of each hole. The rack, which will hold 32 curtains, is rolled out to where the curtains are washed, where it is filled and then rolled into the steam-heated drying room.

Air Brake Hose Coupling Gages

Designs used by eastern railroad for both old and new brake and signal couplings

THE Committee on Air Brake Hose Couplings of the Air Brake Association reported at the New Orleans convention in 1926 that the major portion of brake-pipe leakage was due to defective hose couplings. During the preceding year the committee had made a number of tests on both eastern and western railroads and had found that the standard A.R.A. gages were not applicable for condemning couplings that were unfit for service. It was reported that air-hose couplings which could not be made tight under pressure after the renewal of the gaskets would pass the A.R.A. standard gage in a large number of cases. The committee concluded in that report, an abstract of which appeared in the July, 1926, issue of the *Railway Mechanical Engineer*, page 433, that an improved air-hose coupling gage was necessary if any appreciable reduction in brake-pipe leakage was to be effected.

At the present time there are 12 "go" and "no-go" A.R.A. standard gages for new hose couplings, the use of which, it was contemplated, would assure proper alinement of parts and minimize leakage, if not eliminate it entirely.

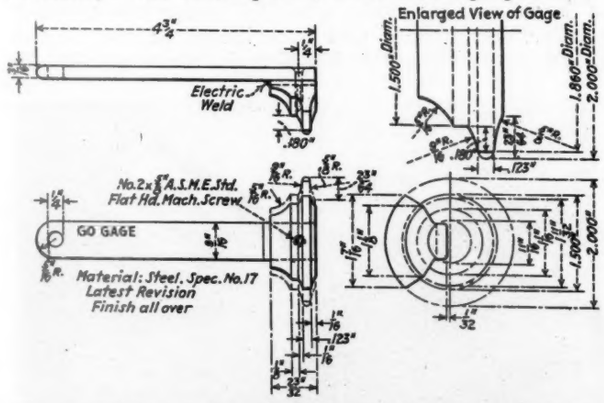

Enlarged View of Gage
Electric Weld
No.2x⅝" A.S.M.E.Std. Flat Hd. Mach. Screw
GO GAGE
Material: Steel. Spec. No.17 Latest Revision Finish all over

Fig. 1—"Go" gage for checking gasket grooves on brake-pipe and signal air hose couplings

The American Railway Association recommends that at least three hose couplings from each shipment of 100, or fraction thereof, but not to exceed 25 from any lot received from the manufacturer, shall be selected and checked with standard gages. Hose couplings represented by samples which admit a "no-go" gage or do not admit all "go" gages shall be rejected.

Standard A.R.A. hose couplings bear the monogram "ARA" and are easily distinguished from non-standard hose couplings. Therefore, hose couplings received from the manufacturers which bear this monogram should pass the A.R.A. standard gages. From the standpoint of economy, new air-hose couplings should be checked at hose mounting shops, rather than after they have been applied to a car. Because the A.R.A. standard gages for new air brake hose couplings are the only ones available, practically all railroads use these gages for checking couplings that have been in service.

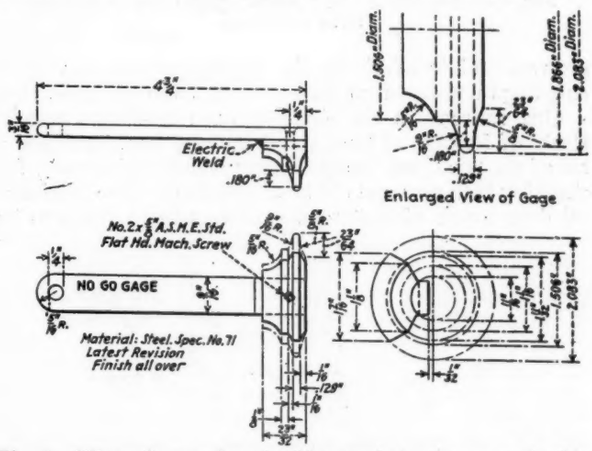

Electric Weld
Enlarged View of Gage
No.2x⅝" A.S.M.E.Std. Flat Hd. Mach. Screw
NO GO GAGE
Material: Steel. Spec. No.11 Latest Revision Finish all over

Fig. 2—"No-go" gage for checking gasket grooves on brake-pipe and signal hose couplings

A number of railroads follow the practice of removing air hose at repair yards and rip tracks, the appearance of which gives a suspicion that there may be leakage, and test the hose and coupling before returning them to

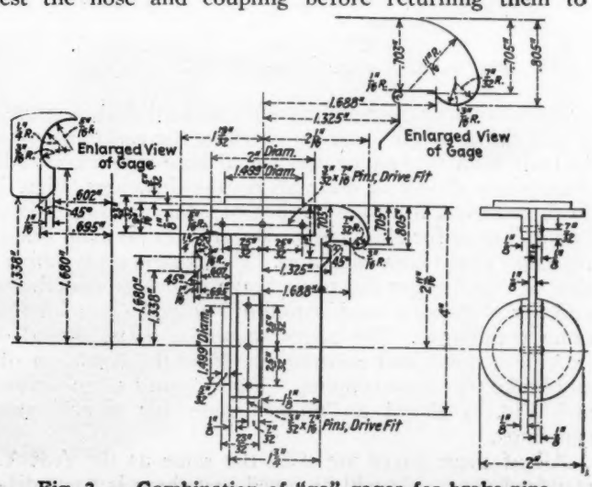


Fig. 3——Combination of "go" gages for brake-pipe hose couplings

service. The limits of wear on the lip bead, lip, lip bearing, guard arm, guard-arm groove and guard-arm bearing of the hose couplings can be more easily checked at the bench than elsewhere. In order to minimize brake-pipe leakage, air-hose couplings should be gaged to insure the maintenance of proper dimensions of gasket

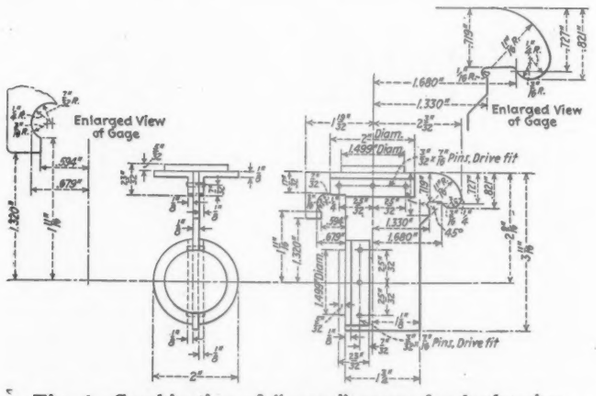


Fig. 4—Combination of "no-go" gages for brake-pipe hose couplings

grooves and to eliminate the continuance in service of couplings which permit air to escape from the train line.

One railroad in the east has been making a special study of leakage at hose couplings and has developed a set of six "go" and "no-go" gages which can be used for checking both new and old hose couplings. The mechanical department of that road considers these gages to be

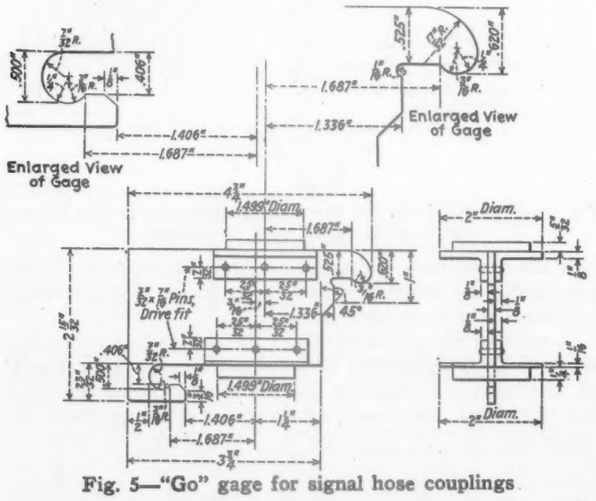


Fig. 5—"Go" gage for signal hose couplings

an improvement over the present standard A.R.A. gages. Fig. 1 shows a "go" gage for checking the gasket grooves in both main brake-pipe and signal hose couplings. All dimensions shown in decimals on the drawings, Figs. 1 to 6, inclusive, have a tolerance of .002 in. Fig. 2 is a "no-go" gage for checking gasket grooves on main brake pipe and signal hose couplings. Fig. 3 shows a combination of "go" gages for main brake-pipe hose couplings, and Fig. 4 shows a combination of "no-go" gages for the same couplings. The gages shown in Figs. 3 and 4 provide a quick and accurate check of the condition of any brake pipe hose coupling. Fig. 5 shows a "go" gage, and Fig. 6 shows a "no-go" gage for signal hose couplings.

All of these gages are used the same as the A.R.A. standard gages. It will be noted that there is some difference in the dimensions and contours of these gages, when the drawings are compared with those of the standard gages shown in the A.R.A. manual. The gages shown in the drawings are now being used at hose-mounting plants. They can be manufactured at a cost

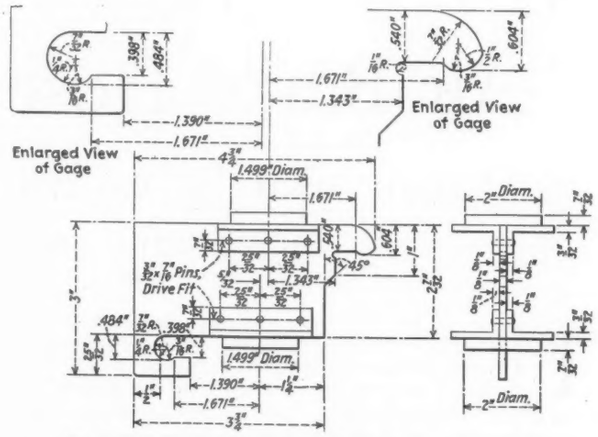


Fig. 6—"No-go" gage for signal hose couplings

of approximately $200. The railroad considers these gages to be a considerable improvement over those of the A.R.A. because they can be used not only for new couplings, but for all couplings going through the hose-mounting shop.

A Kink for the Hostler

IN switching the larger locomotives about the engine-house and turntable, with the tender disconnected, considerable trouble was experienced at the Denver shops of the Denver & Rio Grande Western, with de-

An auxiliary coupler used to prevent derailment while moving locomotives without tenders

railments caused by the usual method of coupling to the draw-bar.

The trouble was eliminated by making the swallow fork of heavy metal shown in the illustration. It is

about 20 in. long. One end is forked to couple over the draw-bar with holes for the pin; the other end is cut to fit closely in the "johnny knuckle," of the switch engine, and fasten with the usual pin. The swallow fork is shown on the front of the shop switch engine, where it is carried when not in use.

Alloy Steels in Locomotive Construction

Economic advantages, necessary precautions and advisability of joint research pointed out in Western Railway Club paper

By Dr. William M. Barr

Consulting Chemist, Union Pacific System, Omaha, Neb.

WHEN power was small and movement slow, no better material for axles could have been selected than the refined iron so much used in early locomotives. Then came plain carbon steel to meet higher stresses and later many roads tried quenched and tempered steel. This treatment of large sections, however, introduced service troubles and was finally abandoned.

Chromium, vanadium and nickel have been successfully used in small forgings since the early days of the automotive industry. When the same practices were first applied to large forgings many difficulties were encountered which were not anticipated by either the steel maker or the forging manufacturer. The designer called for tensile properties beyond the range of plain carbon steels and the maker of alloy steels attempted to meet the tensile strength and high yield, apparently overlooking the properties that made the old iron axle most serviceable. It was easy to make a forging having a yield point above 60,000 lb. per sq. in., but they were satisfied with an elongation of 20 per cent and reduction in area of 40 per cent.

Structural defects, in the form of pipes, gas pockets and segregations were found in large forgings of both the chrome-vanadium and carbon-vanadium steel first offered, which made this material dangerous to use.

A test piece might show physical properties entirely in accord with specifications and even an etched cross section show sound structure, while a service failure developed from gas pockets, segregation or even a pipe existing in another part of the forging. Co-operation between the steel makers, forging manufacturers and railway laboratories gradually eliminated these defects until sound alloy steel can now be obtained with the same degree of certainty as plain carbon steel.

With the removal of structural defects, attention

Low carbon nickel steel rods, illustrating the ductility and toughness of this material—The lower rod was bent cold without rupturing or checking

was turned to failures occurring in sound forgings. The alloy steels are doubtless more sensitive than carbon steel to surface mechanical defects, and many progressive fractures develop from bad fillets, sharp shoulders, tool marks in journals due to hogging cuts, and occasionally in rods from the careless use of a chisel or hammer, or the use of a welding torch. A campaign among the shop forces brought about wonderful improvement until such failures are now rare.

When alloy forging steel was first offered to the railways, comparatively little attention was given to the heat treatment of such material. We were told that a single treatment consisting of normalizing at a temperature of 1,600 deg. F. and cooling in still air gave correct physical properties. A forging of carbon vanadium steel so treated gave:

Tensile strength	124,924 lb. per sq. in.
Yield	79,000 lb. per sq. in.
Elongation in 2 in.	17 per cent
Reduction of area	40.3 per cent

The same material normalized at 1,600 deg. F. and drawn at 1,325 deg. F. gave:

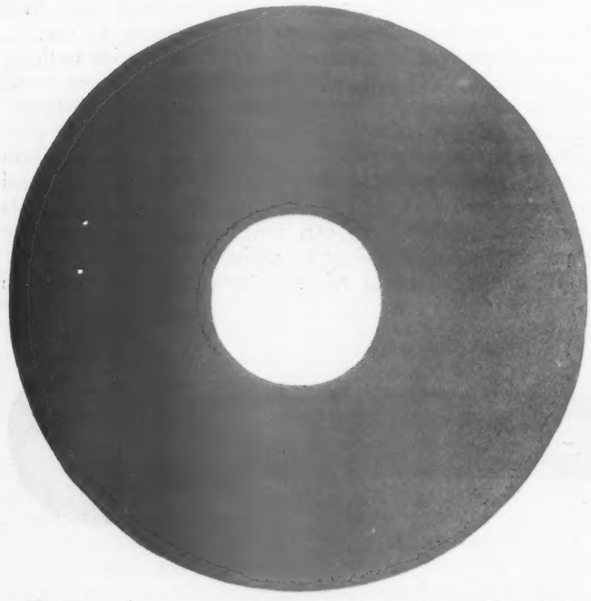
Tensile strength	111,238 lb. per sq. in.
Yield	70,978 lb. per sq. in.
Elongation in 2 in.	22 per cent
Reduction in area	51.9 per cent

These are exceptional physicals and are produced at comparatively small sections. A more representative locomotive forging from a carbon-vanadium steel billet is shown here. The physical properties of this billet are:

Tensile strength	131,518 lb. per sq. in.
Yield	43,106 lb. per sq. in.
Elongation in 2 in.	9.5 per cent
Reduction of area	13.3 per cent

When normalized at 1,650 deg. F. and drawn at 1,250 deg. F., it gave:

Tensile strength	101,898 lb. per sq. in.
Yield	61,488 lb. per sq. in.
Elongation in 2 in.	24.5 per cent
Reduction of area	49.2 per cent



Etching of a cross-section of a low-carbon nickel-steel driving axle, showing sound and uniform structure

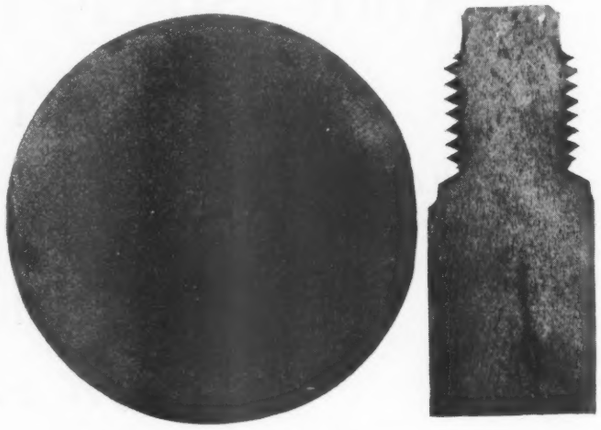
If this class of steel is drawn at 1,325 deg. F., which is close to the low critical point, ductility is improved while sufficient strength is retained to meet the requirements of service.

A carbon-vanadium forging made without heat treatment showed coarse grain structure with granular fracture and gave:

Tensile strength	100,000 lb. per sq. in.
Yield	66,000 lb. per sq. in.
Elongation in 2 in.	3 per cent
Reduction of area	2 per cent

The same forging properly heat treated showed good grain refinement with physical properties similar to those shown above where double treatment was given, with excellent ductility. A section 1 in. wide by ¾ in. thick was bent flat on itself without rupturing.

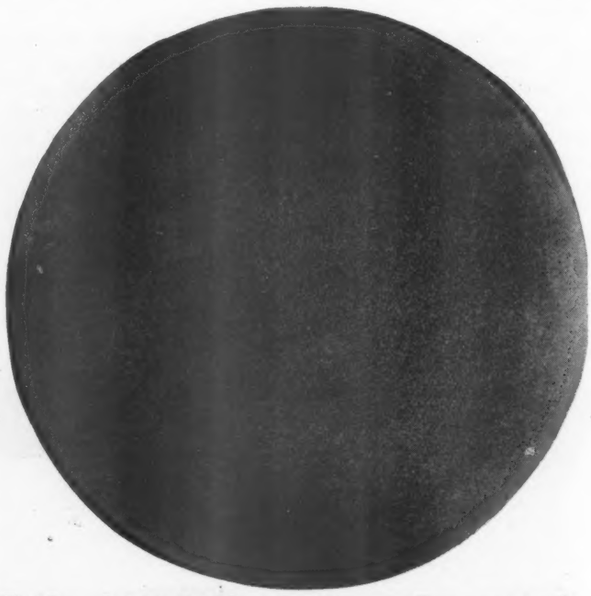
In all cases when normalizing, the piece should remain at the correct temperature in the furnace one hour for each inch of thickness of the section.



Etchings of failed crank pin showing internal structural defects

Lubrication of Journal and Crank Pin Bearings Presents Problem

Not the least of the troubles with high tensile forging steels in locomotive service has resulted from lack of lubrication. In journal bearings and crank pins overheating frequently occurs as a result of loss of lubrication. Sudden cooling of such bearings develops fine cracks on the surface which in time grow into progressive fractures, resulting in failure or removal of the axle or pin before complete failure. Similar heat checks will develop in a journal with repeated heating



Etching of a cross-section of carbon-vanadium steel forging, showing sound and uniform structure

and cooling though the cooling has not been hastened by the application of cold water.

The forging steel that will stand such abuse without checking has not yet been made. Observations lead us to believe that because of the rapid growth of progressive fractures from repeated shocks, increased ductility of the forging steel aids in combating this condition. It is to be noted in the case of vanadium steel that improved heat treatment has raised the ductility until we now have no difficulty in obtaining forgings with a minimum elongation of 25 per cent and reduction of area of 50 per cent. With such forgings our failures have been noticeably reduced.

Nickel steel forgings are now in use on several roads. The use of nickel as an alloy to increase the strength of the steel has permitted lowering the carbon content, making it possible to obtain a high degree of ductility while retaining a yield point high enough to meet the requirements of the designer.

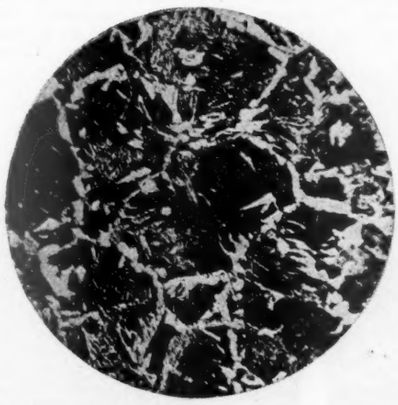
Such a steel has the following composition and physical properties:

Carbon	.20 — .27
Manganese	.75 — .95
Sulphur less than	.045
Phosphorous less than	.045
Silicon	.15 — .30
Nickel	2.40 — 2.90
Tensile strength	80,000—90,000 lb.
Yield	60,000—70,000 lb.
Elongation in 2 in.	30 per cent
Reduction of area	60 per cent

The bend tests show toughness and the steel has good machining characteristics. Whether or not a steel with such properties will be slower in developing heat cracks and progressive fractures must be determined by longer service tests. We believe that the increased ductility and toughness will result in retarding the progress of heat checks. Examination of a heavy crank axle that had been severely overheated and left in service for some time after the heating occurred showed the maximum depth of the cracks to be ⅛ in.

There is little doubt that alloy steels for this service are here to stay, and the important problem still demanding solution is that of lubrication.

While the large forgings make up the largest tonnage of alloy steel in the locomotive, the same changes that have brought them into use have been responsible for new alloy steels being applied to other parts of the locomotive.



Photomicrograph showing the grain structure of an untreated forging of low-carbon nickel steel

Alloy Steel Bolts, Boiler Plates, Flues and Springs

On some of the larger engines the iron or mild-steel bolt has been replaced by low-carbon nickel steel or a chrome-nickel steel such as S. A. E. specification 3130. The composition of this steel is as follows:

Carbon	.25 — .35
Manganese	.50 — .80
Chromium	.45 — .75
Nickel	1.00 — 1.50
Sulphur	.045 max.
Phosphorous	.040 max.

This steel gives good physical properties by normalizing with ample strength for heavy bolts. This steel so treated will give a tensile strength of more than 100,000 lb. per sq. in. The same steel, annealed, will show a tensile strength above 80,000 lb. per sq. in. The toughness obtained by the use of both chromium and nickel gives excellent shock-resisting properties. This material permits quenching, but such treatment is not to be recommended for bolts.

With the great weight and size of present day locomotives, the trend is now toward the development of more power by increased boiler pressures. Most of the engines now in use operate at boiler pressures of 200 to 220 lb., but some have recently been built carrying pressures as high as 280 lb.

Alloy Steel Plates Tested in High-Pressure Boilers

In order to build boilers to withstand such pressures safely without increasing the thickness of the shell, designers are giving consideration to the use of alloy plates. Alloy steels containing two per cent and three per cent of nickel have been used with satisfactory results. Plate has been made from steel containing one per cent of chromium with .15 per cent vanadium, which shows satisfactory physical properties. It is quite probable that such steel will be tested in boiler construction. In the construction of the boiler shell, strength and workability must first be considered.

Some interesting tests, however, have been made, showing comparative impact resistance of some of the alloy steels as compared with carbon boiler steel at elevated temperatures, the results being very much in favor of the alloy steel.

The use of an alloy steel shows many desirable properties. Cases of cracked side sheets after short service in high-pressure boilers have appeared because of the temperatures going over the blue-brittle range of the steel. This experience emphasizes the necessity for developing a new firebox material. Here again the two per cent and three per cent nickel steels have been used, with indications that it will show distinct advantages in service over the present carbon steel. The

Photomicrograph showing the grain structure of the same steel normalized at 1,450 deg. F. and drawn at 1,100 deg. F.

chrome-vanadium plate referred to has also been recommended by manufacturers, but we have no records of service tests on this material.

Corrosion of boiler tubes has long been a subject for serious study. Improvement of water supplies has accomplished much in extending mileage obtained between tube renewals, but the problem of removing oxygen from cold boiler feedwaters has not yet been satisfactorily solved. It is, therefore, desirable to have a material for boiler tubes that will be resistant to corrosion, if such a material can be produced at a cost that will permit its use. Makers of steel for boiler tubes have put various alloys on the market, some of which have been prohibitive in cost, and others which have not shown enough increased life to justify their use. Experiments are now being conducted with boiler tubes containing nickel as an alloy and others with tubes containing copper and molybdenum. Both of these show some advantage over plain carbon steel tubes. Examination of a set of flues recently removed from a Pacific-type passenger engine after 205,000 miles of service shows most of the tubes to be in good condition. Ordinarily a large percentage of steel tubes, after having given 180,000 miles in the same service, must be scrapped. Of 208 tubes in this engine, 40 tubes were found unserviceable, while 168 tubes were returned to service. Fatigue value is an important factor in the life of a boiler tube because of the tendency of the long tubes to develop cracks adjacent to the sheet. Whether or not the alloy tube has an advantage over the steel tube in this respect has not yet been definitely determined.

Use of Nickel Promotes Uniformity in Castings

Many failures have resulted in plain carbon-steel locomotive castings, especially in those that are of such form as to make pouring difficult. Lack of uniformity in the casting is among the chief defects. A large degree of success in improving this condition has resulted from the addition of from ½ to 1 per cent nickel together with some other elements used as scavangers which do not appear as alloys. This practice, combined with improved foundry work, has given excellent results not only by furnishing a casting of more uniform material, but one of higher physical properties. Careful annealing of such castings has been responsible for much improvement in the physical properties.

Although carbon steel is still in general use in spring construction, much work has been done to develop a spring material of alloy steel that will increase the life of the springs and reduce breakage. Chrome-vanadium has probably been used more than any other for this purpose.

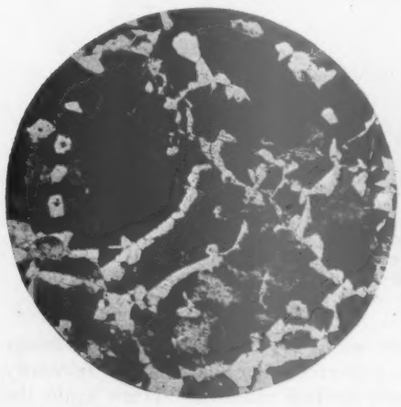
H. T. Chandler of the Vanadium Corporation is credited with the following statement:

A direct comparison between springs in which carbon steel is used and chrome-vanadium practice is perhaps as good a way as any to demonstrate the advantage gained through the use of vanadium steel for railroad springs. Under average manufacturing conditions, and heat treatment, the physical properties of the two steels will be about as follows:

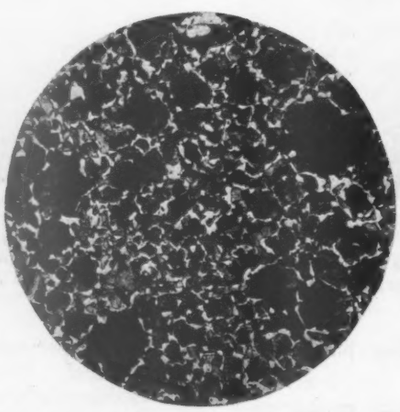
	Carbon	Chrome-vanadium
Elastic limit	135,000	190,000
Ultimate strength	180,000	200,000
Elongation in 2 in.	6 per cent	10 per cent
Reduction of area	15 per cent	30 per cent

(*Continued on page 747*)

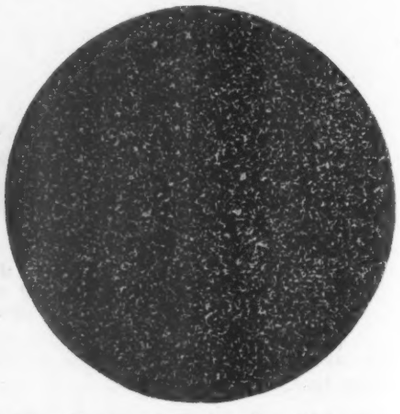
Failed rod showing a progressive fracture developed from chisel marks



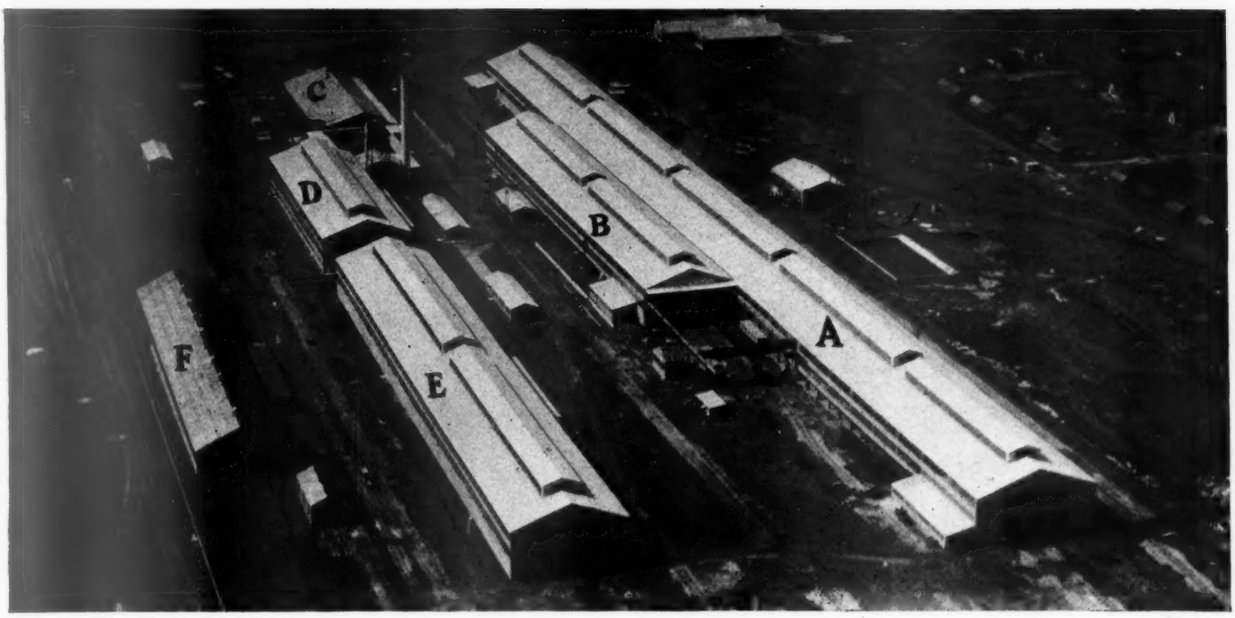
Photomicrograph showing the grain structure of an untreated carbon-vanadium steel billet



Photomicrograph showing the grain structure of the same steel normalized at 1,600 deg. F.



Photomicrograph showing the grain structure of the same steel normalized at 1,600 deg. F. and drawn at 1,325 deg. F.



Aeroplane view of the new Pullman freight car shops at Bessemer, Ala.

Pullman Builds Modern Freight Shops at Bessemer, Ala.

New plant, with capacity for building 25 cars a day, utilizes latest labor-saving equipment and straight-line method of operation

A COMPREHENSIVE program of improvements of facilities for the manufacturing of all types of steel and wood freight cars has recently been completed and put into operation by the Pullman Car & Manufacturing Corporation at Bessemer, Ala. An outstanding feature of the layout and design is the concentration of all principal shop operations into three main units, each under one roof.

The three units consist of the following shop groups, with principal buildings of the sizes indicated. The shops are identified by letters on the airplane view.

1—Steel Group			
A—Steel fabricating and erecting shop	102 ft.	by	1,464 ft.
B—Machine, forge, wheel and truck shop	90 ft.	by	600 ft.
2—Wood Shop Group			
C—Lumber storage shed	80 ft.	by	240 ft.
D—Wood mill	90 ft.	by	312 ft.
E—Wood car erecting shops	90 ft.	by	648 ft.
3—Paint Shop Group			
F—Paint shop	70 ft.	by	400 ft.

In addition to the above units, there are several auxiliary departments such as the template shop, general stores, tool rooms, toilets, wash and locker rooms, boiler room, shop offices, dispensary, waste soaking plant, scale house, etc. Crane storage yards are located at the south end of the steel fabricating shop and at both ends of the machine, forge and truck shop. A monorail fitted with five-ton electric hoists is located over four tracks south of the paint shop. These facilities operate in conjunction with one or more of the three main units. The size and arrangement of each unit has been laid out so as to permit several innovations in car manufacturing and heavy material handling.

Three Grand Rapids dry kilns are located between the lumber storage shed and the wood mill. Each kiln is 20 ft. wide by 120 ft. long. The kilns are served by two 20-ft. transfer tables which operate across each end. Each transfer table has a capacity of two kiln cars.

The boiler plant is operated primarily in conjunction with the wood mill and dry kilns. The building is equipped for the present with two 250-hp. long-drum water-tube boilers, provision being made for a 50 per cent future increase in capacity. The boilers are fitted with by-products gas burners and shavings feeders for firing with either gas or wood waste from the mill. A small grate area is provided for emergency hand firing with either coal or wood waste. The auxiliary equip-

Interior of the steel fabricating shop—High line reaming device in left foreground—Heavy-duty press at the right

ment consists of one feedwater heater and two horizontal steam-driven boiler feed pumps.

Shop Service and Machine Tool Equipment

Crane service is provided in Units 1 and 2. The steel fabricating and erecting shop, including the storage yard at the south end, is served by five 10-ton traveling cranes, two of these cranes being equipped with lifting magnets. The machine, die, forge, wheel and axle and truck shops, including the storage yards at both ends, are served by three 10-ton cranes. The crane runway between the wood mill and the erecting shop is continuous and permits operation of both cranes in one shop or over the transfer table between them.

The machine, tools and furnaces in the several departments, representative of the latest equipment developed for the efficient handling of car-shop work, are shown in the table.

PUNCH, SHEAR, FABRICATING AND ERECTING SHOP—UNIT 1

1—1,500-ton hyd. press with plate handling and cooling beds
1—800-ton hydraulic press
1—750-ton hydraulic press
1—365-ton hydraulic joggling press
1—170-ton by 12-ft. 6-in. deep-gap hyd. riveter set in pit
2—100-ton by 10-ft. 6-in. deep-gap hyd. riveter set in pit
2—50-ton by 3-ft. 6-in. vertical hydraulic riveters
2—50-ton by 2-ft. alligator riveters
2—50-ton by 1-ft. 6-in. alligator riveters
2—Heavy-duty multiple punches with automatic spacing tables
4—Heavy-duty single punches with automatic spacing tables
1—750-ton 12-ft. multiple punch
1—500-ton 12-ft. multiple punch
1—350-ton 12-ft. multiple punch
1—350-ton 10-ft. multiple punch
1—Heavy-duty multiple punch
2—Beam push
1—Stake push
1—Horizontal punch
9—Single punch 20-in. to 60-in.
1—Heavy-duty bulldozer
1—12-ft. gate shear
1—11-ft. gate shear
1— 9 ft. gate shear
1— 6-ft. gate shear
2—Angle shears mounted on turntables
1—Heavy-duty drill press
1—10 ft. long reaming device, high line
1—20 ft. long reaming device, high line
4—60 ft. long reaming device, high line
2—548 ft. long erecting track high line with cranes
3—Continuous furnaces
1—Box furnace
Miscellaneous rivet heating furnaces

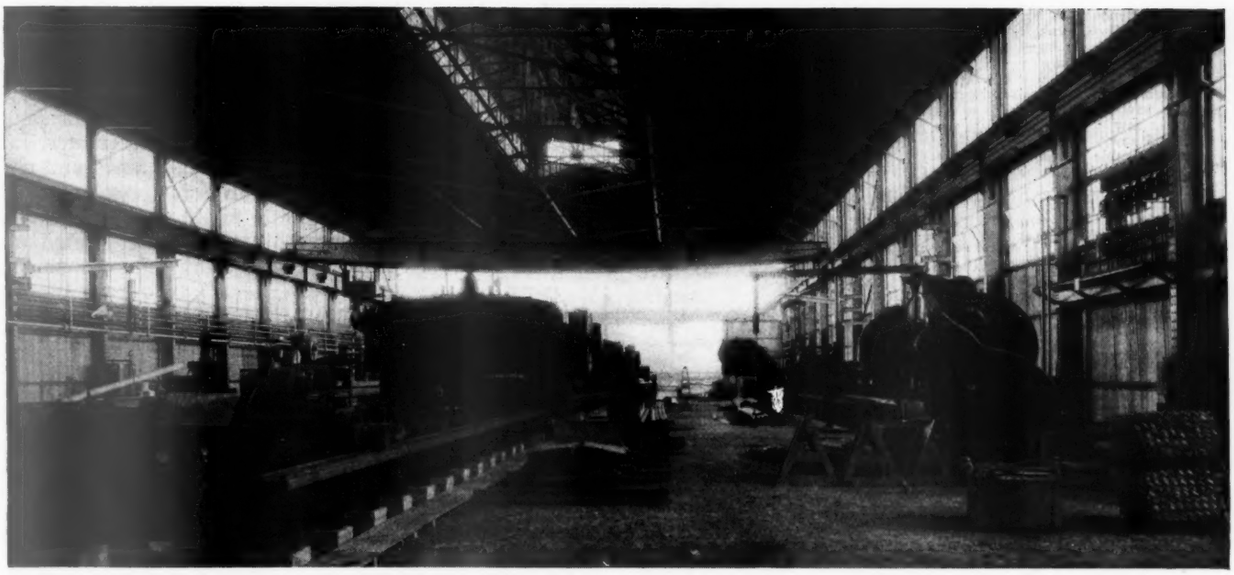
PIPE SHOP—UNIT 1

1—Pipe cutter
1—Double head pipe threader
1—Pipe bender

MACHINE SHOP—UNIT 1

1—72-in. by 72-in. by 18-ft. open-side planer
1—48-in. by 48-in. by 16-ft. open-side planer
1—42-in. by 42-in. by 12-ft. open-side planer
1—36-in. by 36-in. by 16-ft. open-side planer
1—30-in. vertical slotters
2—12-in. vertical shapers
1—Horizontal shaper
1—150-in. horizontal cup wheel grinder
1—Universal grinder
1—Cylinder grinder
1—50-in. by 20-ft. sliding bed cap lathe
1—25-in. by 22-ft. engine lathe
1—22-in. by 16-ft. engine lathe
1—20-in. by 12-ft. engine lathe

Section of the blacksmith shop used for wheel and axle work



Steel fabricating shop—Heavy duty shears and multiple punch with automatic spacing table in the foreground

1—Universal hollow hexagon turret lathe
2—Double floor grinders
1—6-ft. radial drill
1—5-ft. radial drill
2—Vertical drill presses
1—Vertical boring mill
1—Horizontal milling machine
2—Double floor grinders
1—Filing machine
1—Hack saw
1—Abor press
1—8-ft. by 12-ft. surface plate

FORGE SHOP—UNIT 1

1—200-ton hydraulic flanging press
1—10,000-lb. steam hammer
1— 4,000-lb. steam hammer
1—6B Nazel hammer
1—3B Nazel hammer
2—Heavy-duty trimming presses
1—25-in. stock shear
1—Heavy-duty bar shear
1—2-in. forging machine
1—3-in. forging machine
1—No. 3 bulldozer
1—No. 5 bulldozer
3—Single punch
1—Horizontal punch
1—Upsetter
2—Forging rolls
2—Bolt headers
2—Bolt threaders
1—Eye-bolt machine
1—Hot saw
2—Single-spindle drills
2—Multiple-spindle drills
1—Double floor grinder
1—Tumbling barrel
2—Continuous furnaces
12—Box furnaces
6—Blacksmith's forges with motor-driven blowers

HEAT TREATING DEPARTMENT—UNIT 1

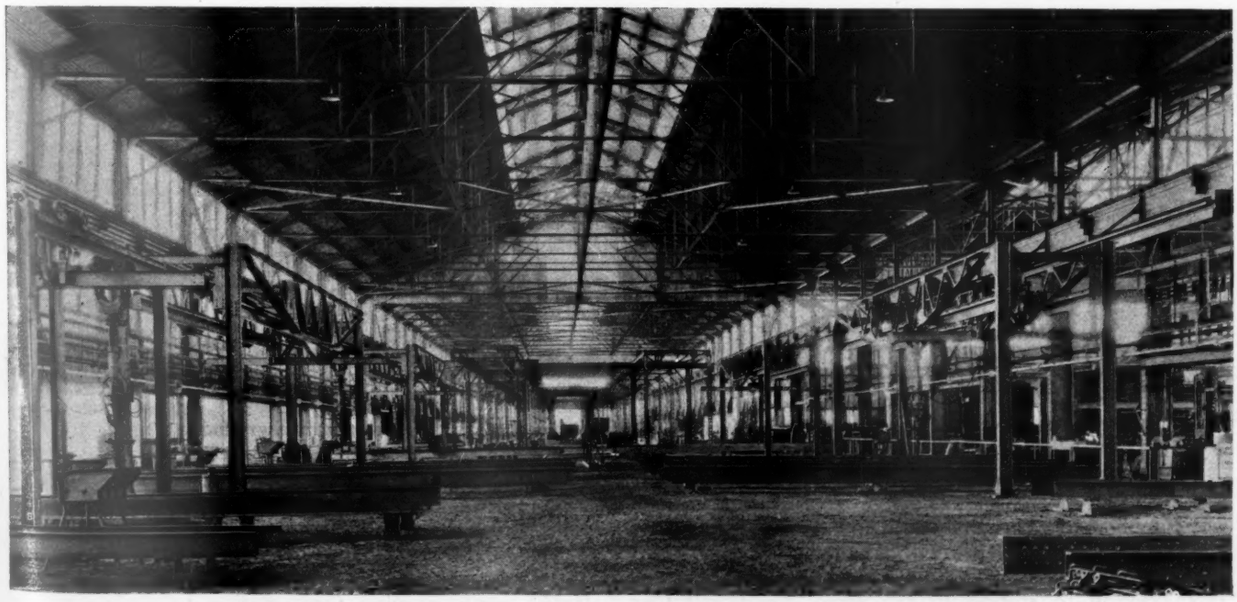
1—150-lb. Beaudry hammer
4—Heat-treating furnaces
1—Anvil
3—Quenching tanks
1—Oil storage tank

WHEEL, AXLE AND TRUCK SHOP—UNIT 1

2—Wheel borers with wheel-handling devices
4—Axle lathes
2—50-ton by 18-in. alligator riveters
1—400-in. wheel press
1—Double high line with cranes

WOOD MILL—UNIT 2

1—Resaw
1—No. 91 Yates planer
2—No. A-4 Yates planer and matcher
1—8-in. by 24-in. surface planer
1—Double saw and tenoner



The steel car assembly shop is notable for ample room, light and crane facilities

1—Single tenoner
3—Swing cut-off saws
6—Multiple-spindle bores
1—Single-spindle bore
1—Variety saw
1—Combination saw and dado machine
1—Rip saw
1—Buzz saw
1—Scroll saw
1—Auto double cut-off saw
1—Double-spindle shaper
2—Car gainers
2—Mortisers
1—Shaper
Shavings and dust collector system with connections to all woodworking tools

TEMPLATE SHOP—UNIT 1

1—Bend saw
1—Rip saw
1—Bench joiner
1—Overhead drilling device

WASTE SOAKING PLANT—UNIT 1

2—12,000-gal. underground storage tanks
2—Oil pumps
2—Waste soaking vats with heating coils
2—Portable waste presses

PAINT MIXING PLANT—UNIT 3

2—12,000-gal. underground storage tanks
2—Oil pumps
5—Paint mixing vats
1—Motor-driven agitator system
1—Traveling barrel hoist

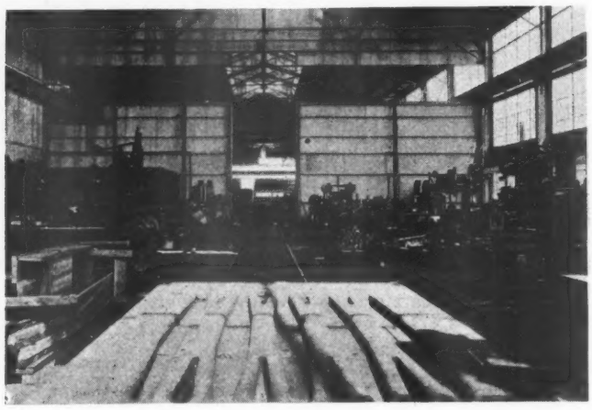
The heavy-duty machine tools, hydraulic presses, steam hammers and substation equipment are set on concrete foundations which are carried down either to natural grade or rock. The lighter machine tools are set either directly on the reinforced concrete floor or on concrete pads 12 in. to 36 in. thick.

Plant Capacity 25 New Cars per Day

The new shops have a capacity for the construction of 25 freight cars per day. The straight-line station-to-station method of car construction was adopted for the new plant. In view of the size of the work and the quantity of heavy, bulky material to be handled through the various departments, material handling was one of the first problems to be settled. After careful consideration was given to both construction methods and all types of material-handling equipment and their adaptability to the straight-line system of car building, it was decided to move all material longitudinally through the shops by means of overhead traveling cranes. By segregating the car construction into three units, consisting of steel work, wood work and painting, all cross-the-yard hauls were eliminated with the exception of small store deliveries and some timber work applied to cars along with the steel in unit 1.

Most of the material is worked through Units 1 and 2 from south to north. Car erection also progresses from station to station in the same direction. Car painting in Unit 3 progresses from north to south.

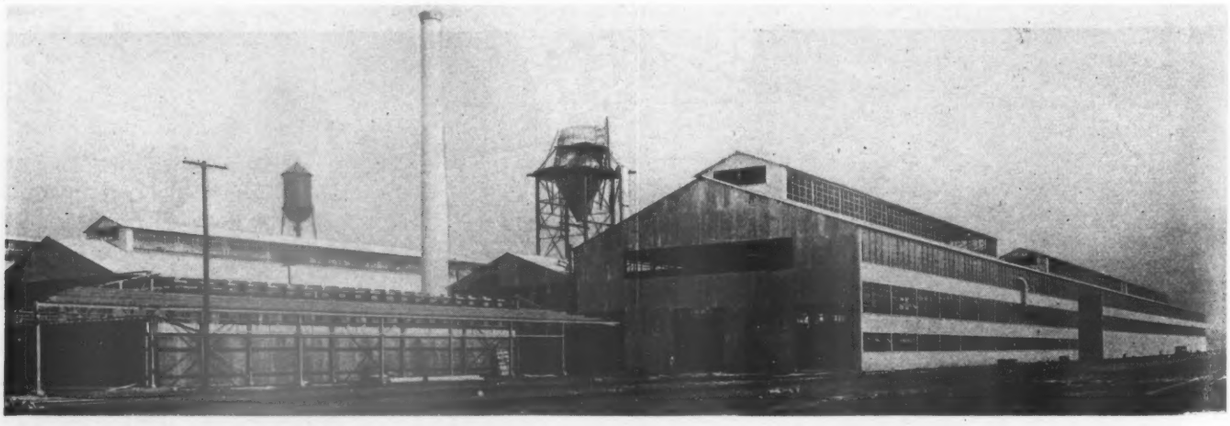
Structural steel, shapes and heavy car parts are delivered to the storage yard, south of the fabricating shop. The overhead cranes handle it from there through various machine departments and keep it moving north to the assembly floor which is located about the middle of the building. Here the underframes, car ends, side frames, roofs, etc., are fitted, reamed and riveted. The pits for the deep gap diveters are so arranged as to permit the storage of 8 to 10 side frames on either side of the riveter. Material being riveted up in these machines is handled by 5-ton monorail hoists located over the pits. This eliminates the use of the traveling crane, except for handling a number of pieces in and out of the pits.



Machine shop interior—Car end-forming die shown on the way to the fabricating shop

Cranes Assist in Material Handling

Machine-die and forge-shop material is delivered to the storage yard south of these shops and handled by cranes similar to the structural steel. Forgings and fittings are moved to the assembly floor by either truck and trailer or small cars operating on a transverse track which runs across Units 1 and 2. Material for trucks is delivered to the storage yard north of the truck shop. In this particular section of Unit 1, material for trucks comes from both the north and south to the truck shop, and as the trucks are assembled and finished, they are moved on their own wheels to the car erection track, turned on small turntables and started north, moving from station to station as the car progresses through the shop to completion. A de-



Dry kiln and wood mill—Power plant and steel shop buildings in the background

pressed track is built along the side of the wheel and axle shop where wheels are unloaded and rolled into the building.

Timber which is applied to the cars in the steel erection shop is either handled from the mill on the transverse shop track or run into the north end of Unit 1 on a stub and track. Some material not requiring fabricating or machining is also delivered for erection at the north end of Unit 1. By this means, crane congestion is eliminated.

Lumber is delivered at the south end of Unit 2 and unloaded by hand into storage or on kiln cars. Owing to the fact that wood cars are becoming obsolete and that the amount of wood used on combination wood and steel cars is decreasing, the installation of lumber-handling equipment in this unit was unwarranted. Lumber from the storage or kilns enters the south end of the wood mill and is handled by the overhead traveling cranes to the various machines and to the erecting floor the same as material in Unit 1.

Cars leaving Unit 1 are switched south along the side of the wood erecting shop to a transfer table and moved into the shop to one of the erecting tracks. There the cars start north over a station-to-station system for wood erection and are completed by the time they reach the north end of the shop. During rainy weather, cars are given a priming coat of paint before being switched to the paint shop. At other times they may be moved into the yard for priming before entering Unit 3.

Four tracks are provided in Unit 3 for painting and stenciling. Permanent paint scaffolds are provided along the sides of the building and portable scaffolds operating on monorails are used between the cars. Cars are moved south through the shop where painting and stenciling is carried out by means of both brush and spray painting. The yard tracks at both ends of Unit 3 are equipped with compressed-air service outlets for testing and inspecting various car appliances. Before the cars pass out of the yard, they are run over a track scale, weighed and inspected. Final adjustments are made at the yard monorail station and from there the cars are switched into storage to await delivery.

The new plant was designed and constructed by the United Engineers & Constructors, Inc., of Philadelphia, under the direction of W. N. Oehm, manager of works of the Pullman Car & Manufacturing Corporation.

Alloy Steels in Locomotives

(*Continued from page 742*)

In addition to these tensile properties, and of more practical importance, it has been found that the safe commercial stress range for carbon steel is somewhere between 55,000 and 60,000 lb. per sq. in., while in the case of chrome-vanadium it has been found safe to increase this to 75,000 to 80,000 lb. per sq. in. Also, the fatigue and impact values, no matter how measured, are very much superior in the case of chrome-vanadium steels.

For motion-work parts or other places where there is excessive wear, alloy steel is used with good results. Chrome-nickel steel forgings to S. A. E. specification 3145 have been very satisfactory. This steel has the following composition:

Carbon	.40 — .50
Manganese	.50 — .80
Chromium	.45 — .75
Nickel	1.00 — 1.50
Sulphur	.045 max.
Phosphorous	.040 max.

Steel conforming to this chemistry when heated slowing to 1,500 deg. F. and quenched in oil, then drawn at from 950 deg. to 1,000 deg. F., gives an excellent material for motion work parts.

Good Results Anticipated with Nitralloy

To take the place of case hardened material which is sometimes used for link blocks and pins, and crosshead guides, the new alloy known as Nitralloy is now under test on a number of roads with promise of good results. This steel is of the following chemical analysis:

Carbon	.10 and upwards
Manganese	.40 — .70
Silicon	.20 — .30
Aluminum	1.00 — 1.25
Chromium	1.50 — 1.75
Sulphur	.030
Phosphorous	.030
Molybdenum	.15 — .25

It is readily forged, readily heat treated and takes a high degree of finish by ordinary shop methods. A wide range of physical qualities can be secured, depending upon the type of heat treatment applied. This steel is forged, treated to the desired physical properties and machined, after which the process known as nitriding is applied to produce a high degree of surface hardness. The material must be finish machined complete before nitriding as further machining is impossible after hardening. The surface develops a degree of hardness between 900 and 1,000 Brinell. The process of nitriding is carried on in a sealed container where the material is treated with anhydrous ammonia under atmospheric pressure at temperatures varying between 900 deg. and 1,000 deg. F. It is necessary to hold this material under treatment sometimes as long as 90 hours.

This process produces an extremely hard surface while the strength of the core has not been affected because of the low temperatures used. The advantage of this material over casehardened steel is that it can be finish machined before treating, and there is no distortion produced by the process. It gives a surface that does not spall or flake off and will retain most of its hardness up to 1,450 deg. F., with no loss up to 932 deg. F. The slight change in thickness which occurs is so uniform that it can be allowed for in the machining. While this steel has not yet been used in many locomotive parts, it shows great possibilities wherever surface wear is the chief factor to be considered and is worthy of careful consideration.

Joint Railroad Research Recommended

It it evident from what has been said that much work has been done on the development of the various alloy steels and their application in locomotive construction, both by the producers and the railway laboratories. There is so much still to be accomplished that, with the railway laboratory forces burdened with so much routine work of such great variety, progress is necessarily slow. These problems, with the many other material problems of the railroad demanding solution, make it appear that the railways of the country could not do better than to pool their efforts, and following the example of a number of other large industrial organizations, establish a research laboratory in which such problems may be independently worked out unhampered by the daily operating cares that now infest the railway laboratories of the country. Such an organization would make larger returns on the investment, would speed up results, and the work would be for the good of all.

A repair track, or rip track, should locate in close proximity to the inspection or classification yard—A track of sufficient capacity to handle loaded cars should be so designated, pulled and respotted each hour or less, if necessary

Present Day Demands of the Repair Track

The car department supervisor's responsibilities are increased by greater train mileage

WITH increased train mileage, elimination of numerous repair tracks and inspection points, came a need for a more systematic classification of inspections at initial terminals, loading points and interchange and junction points. Car department supervisors were confronted with facts which made expedient a drastic change in former inspection methods and repair-track organization. Where inspection and repair-track forces were formerly located at each division point and were responsible for disrupting each and every through or main track train, only one of each three such points were found necessary. This brought about an adjustment of forces at some points by the elimination process and by strengthening at others. This brings us to a consideration of our present service requirements.

Increased inspection forces, more diligent observation by car inspectors at initial terminals, loading and interchange points, naturally increased the number of bad order cars on the repair tracks. Car inspectors were familiarized with the fact that equipment had to be maintained to a high standard in order to avoid delays to trains enroute, therefore any car which in the opinion of the car inspector was not in condition to insure its uninterrupted journey to destination was sent to the repair track.

A repair track or "rip track," as it is generally known among railroad employes, should be located in close proximity to the inspection or classification yard in order to insure a more expeditious placing of cripples and closer contact between repair-track and operating-department supervisors. The repair-track organization should realize that too much attention cannot be given to the work performed or, we might say, work not performed, for it is of vital importance that cars leaving the repair track be in condition to carry a load to the final destination or, if empty, in condition to be placed for loading and continue uninterrupted destination after loading.

Repair Track Problems

Dealing briefly with some of the repair track prob-

lems we might well begin with the proper switching of tracks. A track of sufficient capacity to handle the loaded cars should be so designated and with proper supervision can be pulled and re-spotted each hour or less, if necessary, to insure cars continuing in the same train to destination, or be available for movement in the next scheduled train. Competent employes and the most efficient supervision must be maintained on load shop tracks to insure repairs being properly performed.

Loading, especially on open-top equipment, must be carefully checked to ascertain whether it has been loaded in accordance with the A. R. A. Loading Rules and that it has not shifted

Empty cars and slow moving loads should be placed on designated repair tracks and pulled every four hours or oftener if necessary. The switching of these tracks during the noon lunch period will be found advantageous, for the reason that new cars can be re-spotted for repairmen before they return to work. If the noon pull is made an established practice it will be found that greater effort will be put forth toward completion of the work on each car by the mechanic, knowing that failure to have it completed will tie up the entire track. This feature must also be followed closely by the supervisor in charge of the work.

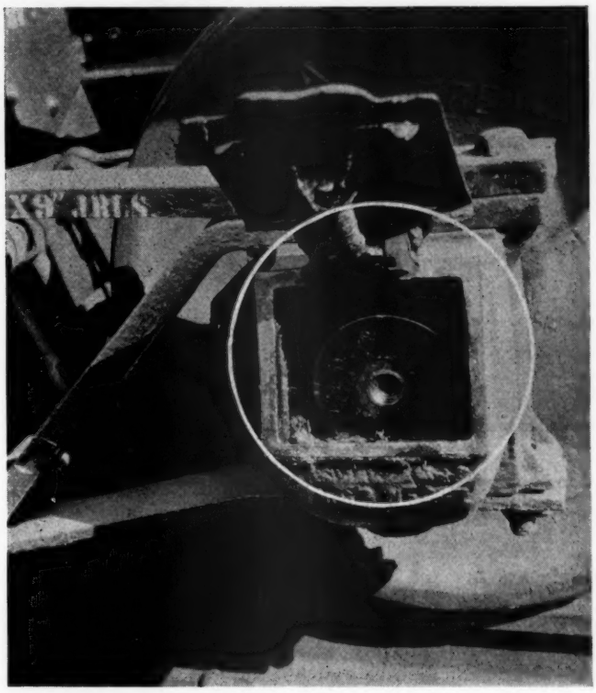
All cars coming on the repair tracks should have the brakes tested with the single-car testing device and all tests made in proper order

Co-operation of the operating department, where switching crews are under its orders, is essential.

Cars on the repair track should be checked to establish that they are free of defects in addition to those for which they were shopped, or bad-ordered, before being restored to service. The following parts should be carefully inspected and repaired:

Parts Requiring Close Attention

Arch bars and cast steel side frames should be inspected for cracks or flaws. A mirror, placed on a wire handle, can be used to reflect the inside edges and has been found effective for locating flaws. The edges



Journal boxes on cars coming on the repair tracks should be examined and additional sponging added as required. All packing should be set up in the box according to A.R.A. instructions

of arch bars or side frames can first be given several taps of a hammer so as to loosen rust or scale.

Brake beams having the top portion of the hanger eye worn to one-half inch or less, or having the bottom lug worn to one-half inch or less should be removed from service to prevent failure. Likewise brake beam hanger brackets having pin holes enlarged by wear 5/8 in. or more over the original diameter of the hole or having brake beam hanger pins worn 1/4 in. under the original diameter should be renewed.

Wheels, condemnable by the A. R. A. wheel gauge, or having flanges sufficiently worn to warrant shopping before the car completes trip should be removed.

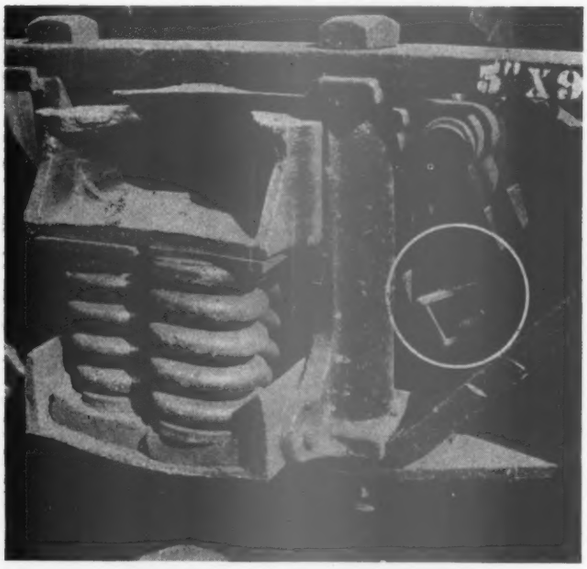
Loose column and journal box bolts should be tightened and where worn, renewed.

Broken or cracked spring planks and spring beams should be renewed or repaired. Where fulcrum bar safety straps are standard they should be properly maintained.

Care should be exercised to see that side bearing clearance is not less than 1/16 in. or more than 5/16 in. between all four side bearings when balanced on the center plate on cars equipped with a metal body and truck bolsters.

Couplers and parts should be examined to prevent

failure. Uncoupling arrangements too taut which would cause knuckle locks to raise; broken or worn knuckle pins and worn knuckles which would cause a coupler to be out of contour should be renewed or repaired. Draft gears if found with ½ in. or more slack should be removed and repaired, or replaced with a new draft gear. By eliminating slack in draft gears each



A mirror with a wire handle can be used to reflect the inside edges and has been found effective for locating and detecting flaws or cracks

time cars are on the repair track a great amount of trouble, due to broken sills, break-in-twos, etc., can be prevented. After repairs have been made to draft gears, the draft barrel, as well as the side of the car should be stencilled to indicate the last date that repairs or an inspection was made. This should preferably be each eighteen months on cars that are three years of age or older.

Air Brake Tests

No car should be allowed to leave the repair track on which the stencilling indicates that nine months or more have elapsed since the last date of air brake cleaning. A competent air brake repair force should be maintained and periodical checks made by the car foreman to see that all work is performed in accordance with A. R. A. rules. All cars coming on the repair track must have the air brakes tested with the single-car testing device and all the tests made in proper order, namely:

Brake pipe leakage test. Application test. Release test. Emergency test. Service stability test. Brake cylinder leakage test. Retaining valve test.

Soap suds for soaping triple-valve connections and for detecting leakage around the angle cocks and air hose must be provided. An adequate supply of pipe connections and other air brake repair parts should be accessible.

Attention to Journal Bearings and Packing Important

Intelligent, systematic and periodical attention to the proper preparation of packing, treating of journal boxes, condition of journals, brasses, journal bearing keys, boxes and lids is essential to the cool running of journals. All journals should be thoroughly cleaned and polished before the wheels are applied. A canvas or cotton-duck belt, wrapped once around the journal and worked back and forth will polish the journal nicely. The use of emery cloth, emery paper or sand paper on journals should be prohibited. Proper preparation and care of packing at the oil house is an important feature and deserves the personal attention of the car foreman to see that oil of the correct grade is used; that packing is saturated for the required length of time and, where reclamation of sponging is handled, that it is thoroughly cleaned before being placed in the vat for soaking.

It is not considered good practice to transfer journal bearings to new wheels regardless of the re-fitting facilities. New journal bearings should be cleaned and fitted to the journals. A half-round file or cabinet makers' scraper are excellent for this purpose. The surface of the brass should be given a heavy coating of valve or car oil before it is applied. Journal bearing keys (wedges), before being applied should be gaged to see that they are not worn flat on top, lengthwise for a distance exceeding the original diameter of the journal. Where defective keys are found they should either be scrapped or reclaimed before application.

The packing of journal boxes must conform to instructions contained in the A. R. A. rules. Periodical packing each 12 months is essential and necessary, and under no circumstances should the stenciling be changed unless all the boxes have been entirely repacked. Cars on the repair track with stenciling indicating that nine months or more have elapsed between the last date of packing, should be repacked. When boxes are repacked it is necessary that the journal bearing and key be removed and examined; also to see that the journal box is thoroughly cleaned out before repacking to insure the box being in good condition for 12 months service with the least amount of attention during that period.

The following table shows the recommended amount of sponging to be used in the various size journal boxes when they are repacked:

4¼ in. by 8 in.	5½ lb.
5 in. by 9 in.	7½ lb.
5½ in. by 10 in.	9 lb.
6 in. by 11 in.	11 lb.

Journal boxes on cars coming on to the repair tracks should be examined and the front pieces removed (where front pieces are used), shaken out, additional sponging added as required and all packing set up in the box according to the instructions contained in the A. R. A. rules. The front piece should then be replaced. Care must be taken to see that the front pieces are not pushed back under the journal as this piece usually contains grit and dirt and is liable to cause the box to overheat.

Free oil should be applied to journal boxes where the sponging appears to require it, however it should not be applied to all boxes regardless of their condition.

Careful inspection of all sills, doors, roofs and safety appliances must be made to insure against a car being shopped out of a train for defects in these parts.

Loading, especially on open top equipment, must be carefully checked to ascertain whether it has been loaded in accordance with the A. R. A. Loading Rules and that it has not shifted, in order to prevent falling from cars or causing a delay to a train due to the necessity of shopping a car.

To each car dispatched from the light repair track a small card bearing the station, date and foreman's name should be affixed, to indicate that the car has had all defects corrected and is in suitable condition to reach its destination without further repairs being necessary.

The Reader's Page

Interchange Inspectors Agents of the A.R.A.?

New Haven, Conn.

To the Editor:

In his address before the Master Car Builders' and Supervisors' Association convention at Chicago in September T. W. Demarest, general superintendent of motive power of the Pennsylvania, said that it might be necessary for the A.R.A. to take over the local interchange work if the chief inspectors did not cease to abrogate the rules as soon as they were published.

It is not surprising to hear that three or four interchange inspectors fail to agree on a proposed recommendation to the Arbitration Committee of the A.R.A. The minutes of the meetings of the old Chief Interchange Car Inspectors' and Car Foremen's Association of America indicate very clearly that these men seldom agree unanimously on any question, whether it be a recommendation for a change in the rules or the interpretation of the new rules. It must be remembered that these men are located in various parts of the country and that their opinions are more or less formed by local conditions and advice. I fail to see any harm in this difference of opinion; on the contrary, I consider it wholesome. When different opinions are expressed by such a body of men it usually stimulates interest and discussion that leads to the ultimate goal; that is, the most feasible solution of the problem under discussion. As to the administration of the rules, however, would it not be far better for all the railroads concerned if the change which Mr. Demarest said might have to be carried out were in effect so that at each important interchange point the A.R.A. would have a representative? This would cause a more uniform application of the rules than is now in effect. I dare say that the transfer of authorities would decrease to a considerable extent and this alone would effect a great saving to the railroads. Car owners would all be treated alike, whether or not their territories touched a specific chief inspector's district.

I have often wondered why the various car owners have not asked for some kind of protection when a car is reported to them under Rule 120. How often does the car owner take advantage of making an inspection of a car reported under Rule 120? If an actual check were made, it would probably show about once in ten times.

The thought that I have in mind is to have the chief interchange inspector in the district where a car is reported under Rule 120 make an inspection of a car and all data pertaining to it. This, of course, would be on condition that the car owner would take advantage of this privilege. The basic reason why car owners do not as a rule make an inspection of a car reported under Rule 120 is that the car is usually located from a few hundred to a few thousand miles from the owner's line, and the expense to send a man out to make an inspection under these circumstances is prohibitive. It would take a high priced man from a few days to two weeks in some instances to make an inspection of a car and investigate the circumstances under which the car was damaged.

To cause a car to be inspected by a disinterested party may bring out many facts not revealed in the write-up. This fact is brought out very plainly in not a few cases reviewed by the Arbitration Committee. The mis-statement of facts in most cases is brought about by ignorance or incorrect interpretation of the rules rather than by any deliberate misrepresentation.

For this reason it would benefit the railroads as a whole for the A.R.A. to have the chief interchange inspectors under its wing, and the various committees of the A.R.A. could get accurate information at any time from these men if they reported to the A.R.A.

These men could then supplement the work now being carried out by the A.R.A. mechanical inspectors. These inspectors visit a railroad once in a few years and in most cases find conditions far from perfect. A chief interchange inspector could make checks in local districts, say semi-annually or annually. This would be far better than no check at all by the A.R.A. One must not forget that the mechanical inspectors find many undercharges as well as overcharges when checking the records of the railroads.

The roads as a whole would attempt to live up to the rules as written if they knew that these records were going to be checked periodically by a representative of the A.R.A. This may all sound revolutionary to many, but, nevertheless, the facts justify the suggestion. First, chief interchange inspectors should be agents of the A.R.A.; second, they should inspect all cars reported under Rule 120, and, third, they should supplement the good work being done by the A.R.A. mechanical inspectors.

I should like to read the opinions of others who have given this matter any thought, especially those who are against the arrangement suggested.

J. W. McDonnell.

Maintenance of Draft Gears

Parsons, Kan.

To the Editor:

In the October issue of the *Railway Mechanical Engineer* under the report of the convention of the International Railway General Foremen's Association I was very much impressed by the report of the Committee on the Inspection and Maintenance of Draft Gears.

I have been employed in the capacity of piecework inspector and write-up clerk for a period of more than ten years and during that time I have especially observed the condition of many types of draft gears on railroad cars.

My experience has led me to believe that there should

be a periodical inspection of all draft gears, considered from an economical as well as a practical point of view. The length of the periods would depend upon the kind of gear. Some gears should be removed for inspection every five years; other gears that are equipped to take up the slack after slight wear, without removal, should be good for a period of service, extending from eight to ten years.

Furthermore, when this inspection is made and parts renewed, old parts should never be used for renewals as this is a waste of time and money; common sense tells us that the old parts can not have the wear of new parts and such repairs will necessitate repairs again before the alotted time.

Some railroads have many cars that are equipped with friction draft gears that have been in service so long that the type of gear is practically obsolete, and when this equipment gets on a foreign line the gear sometimes fails. Because of the stencilling on these cars, the road making repairs is compelled either to make temporary repairs or to be penalized for a labor charge. In justice to the owners as well as to the road making the repairs, the rules should be changed permitting the road making the repairs to apply one of the later type friction gears and change the stencilling of the car accordingly.

J. P. O'CONNOR,
Write-up Clerk, Missouri-Kansas-Texas

Comparing Costs—How Do You Figure Overhead?

BOLTON, LANCASTER, ENGLAND.

TO THE EDITOR:

It has been my experience on numerous occasions to hear foremen making comparisons between the cost of work as carried out in their own departments as against the cost of the same work done in another shop—usually, it must be admitted, to their own advantage. They may say, for instance, "It costs me ten dollars to do this job, while it costs fifteen dollars in the other shop."

I often wonder if such comparisons are really worth while and, when they speak about costs, what they really mean? Do they mean just the wages paid to the operator in each case, or do they refer to the "all-in" costs; namely, wages plus overhead? If the latter, and they can prove their statement all well and good. But if the former, it does not necessarily follow that a lower wage cost means a lower total cost. To obtain a reduced wage cost the railroad may have had to install new equipment, and unless the saving in wages more than balances the increased expenditure in interest, depreciation, etc., the result can easily be the reverse of that anticipated. Many shop foremen have vague ideas on this subject.

I remember a job of planing cylinders which had been done for years in a shop where one man operated two machines, which resulted in a fairly low labor cost, but not in a quick output. Some time later the job was put on a high-speed planer where one man was kept busy all the time. The wages charged under the old method were lower than on the new machine, due to the operator's time being divided between two machines. The total time, however, for planing one pair of cylinders was much longer by the old method, and therein is the snag.

The idea of cost which is prevalent in many minds is to consider first the wage cost, and add a percentage to cover the overhead. By such a procedure the result in the case of the two old planers was that because the wages were low they did not contribute their fair share to the indirect charges of the shop. However, a different aspect was placed on the subject when a system was introduced which charged the indirect expense against each job according to the time taken and the class of machine used. The use of the high-speed machine, although costing much more per hour to run than the older types, was a good paying proposition. It would be well if everyone was clear on this point. But until we separate overhead in our minds from wages and regard them as a separate item, so long will the possibility of erroneous conclusions exist.

W. A. JONES

* * *

Two men with hand trucks are required to transport a single equalizer, but four equalizers weighing 600 lb. each can be handled with greater ease by the use of crane type trucks

Electric Operated Locomotive Mover

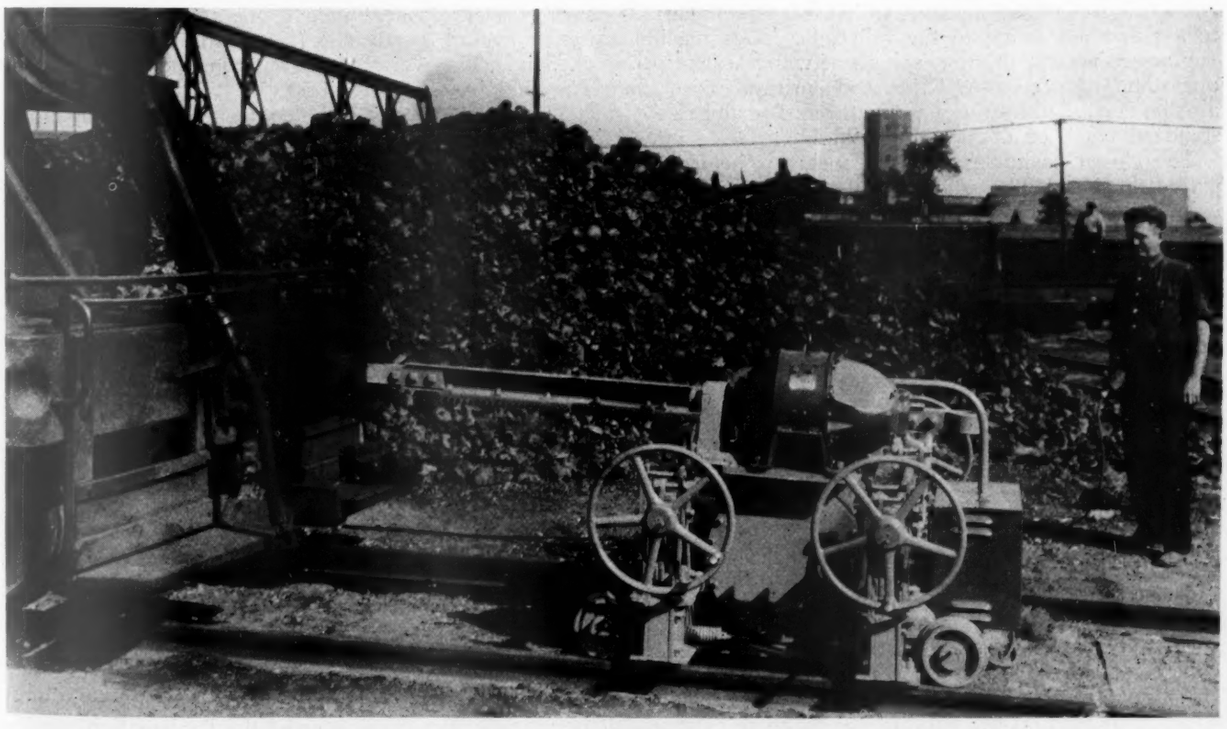
THE need of an improved method of moving dead locomotives has long been felt in enginehouses and repair shops as modern locomotives are too heavy to move readily with pinch bars. The use of shop switchers not only ties up power but impedes the turntable service and the work of the transfer table.

To overcome this difficulty, the Whiting Corporation, Harvey, Ill., has developed an electric locomotive mover, designed to save time and labor in moving dead locomotives. This patented machine consists of a steel structure 3 ft. in height mounted on four flanged wheels, equipped with roller bearings, which are spaced for standard-gage track. The entire truck is less than 5 ft. in length and can be easily moved by one man on the track. The mover can be lifted from track to track with a crane, by an eye in the center at the top.

A 5-hp. motor mounted on the truck drives a horizontal beam through a series of gears at a rate of 5 ft. per min., with ample power to push or pull any locomotive from the smallest type to the heaviest Mallet. The beam is furnished in any length required.

A special coupler fitted at either end of the beam may be attached to either the knuckle pin or the draw bar pin of the dead locomotive. When the beam is in its normal position, its coupler height is that of A.R.A. requirements. The beam is adjustable, by means of regulating springs, to any desired coupler height.

When a locomotive is to be moved, the device is first



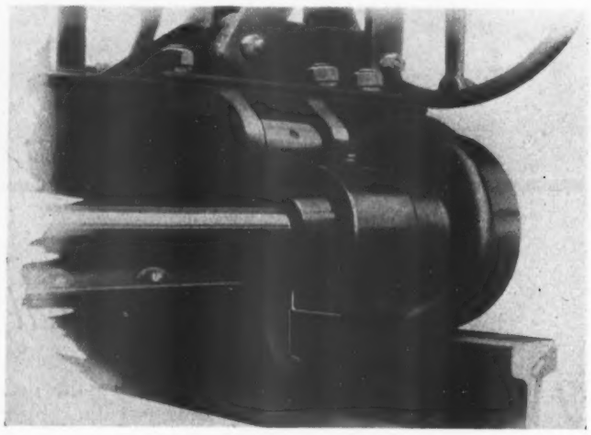
Whiting electrically-operated locomotive mover coupled-up ready for service

locked to the rails by means of the clamps, one for each wheel, gripping beneath the ball of the rail and drawing the truck frame downward until its serrated steel blocks grip the top of the rail. The hand wheels, two on either side of the truck, work the clamping mechanism. A spin of the wheel completes a solid anchorage.

The motor, operated by push-button control, pushes or pulls the beam to the locomotive and connection is made with coupler or drawbar. After coupling, the operator stands beside the locomotive and controls the spotting as the locomotive is pulled or pushed along. Precise control makes it possible to spot the locomotive on the dot. If, at the end of the beam's travel a greater movement is desired, the mover is released from its anchorage and re-anchored again where desired with the beam still attached to the locomotive, which is a moment's job.

After the locomotive is spotted, the beam is released and moved back to its mid-position in the truck, the electric cable is disconnected from its wall receptacle and the locking mechanism released. The locomotive mover is now ready to be moved for service to some other part of the shop.

Applications of the Whiting locomotive mover include spotting for drop pit table work; locating front and back dead centers in setting valves; running locomotives over for squaring up valves; getting crank pins on the bottom quarter for applying and removing side rods; spotting front wheels and crosshead for application and removal of the wrist pin; spotting shop engines to relieve interference; placing locomotives under smoke jacks, and connecting the locomotive tender to its locomotive.

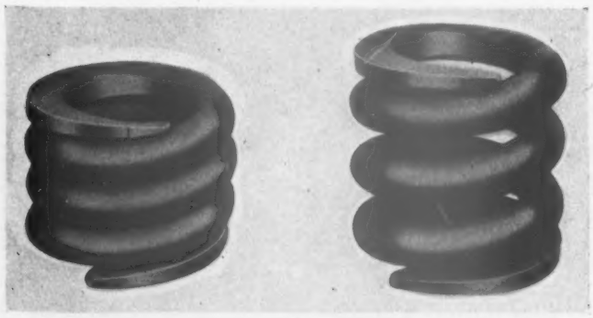


The serrated block and clamp which grips the locomotive mover to the rail

Reclaiming Coil Springs

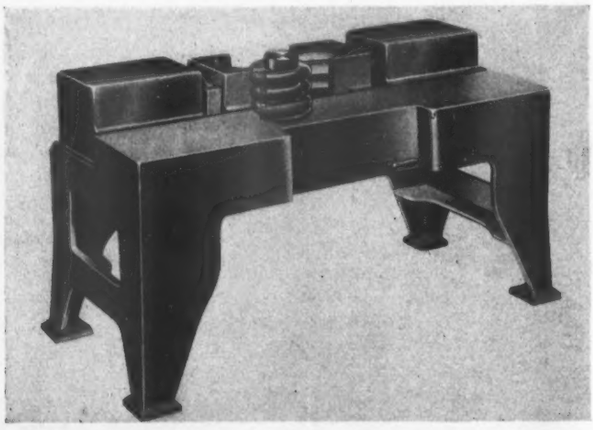
THE Reclamation Service Company, Syndicate Trust building, St. Louis, Mo., has developed a coil spring reforming machine which it is now manufacturing and marketing to the railroads. This machine can be equipped with dies, each set of which will reform one standard size of A. R. A. coil springs. Dies can also be furnished by the manufacturers for any size of standard truck or draft-gear spring.

The closed or mis-shapen coil spring is heated and placed on the mandrel shown in the center of the machine. The closing of the dies opens the coils to the correct height, and also allows for initial set. The machine is operated from the shop airline at approximately 100 lb. pressure. Only one operating valve is required, which is located on the front of the machine as shown in the illustration. Turning the handle to a horizontal position opens the dies. To close the dies, the handle is turned to a vertical position. Closed or mis-shapen springs are reformed in one operation. The machine has an overall length of 5 ft. and an overall width of 2 ft. 5 in. The working height from the floor is 28 in. The shipping weight is 1,500 lb.



Left: Spring before reforming. Right: Spring after reforming

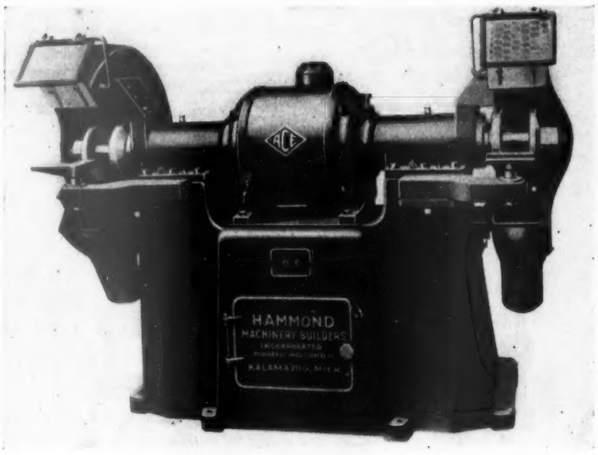
This machine was invented by J. H. Chancy, foreman blacksmith, Georgia Railroad, Augusta, Ga., who also conducted the preliminary development work until the patents were taken over by the Reclamation Service Company.



The spring reforming machine with the dies open and a phantom view of a coil spring in position on the mandrel

Ace Heavy-Duty Electric Grinder

THE Hammond Machinery Builders, Kalamazoo, Mich., have recently placed a series of heavy-duty floor grinders on the market designed to meet the demands for a machine with maximum power and rigidity. These floor grinders are furnished with motors of 5, 7½ and 10 hp. for operation on either direct or alternating current. The motors are of the fully enclosed type fitted with a patented air cleaner and oversize ball bearings in which are mounted an extra-heavy spindle of chrome-mangenese steel. An automatic motor starter having thermal overload protection with a push-button control conveniently mounted on the pedestal is standard equipment. The complete guard is adjustable to compensate for the wear of the grinding wheel.



The Ace grinder is equipped with a fully-enclosed air-cooled motor

The motor is of the 40-deg. Cent. type fully enclosed but cooled through an air cleaner. The motor is designed to withstand a momentary overload of 100 per cent beyond its rated capacity. The air cleaner supplies clean air to the motor discharging dirt and dust from the air before it enters the windings. The bearings in the machine are optional, either high-grade ball bearings, completely enclosed and protected from dust and grit by double labyrinth seals, or Timken tapered roller bearings. The spindle of the machine is made of chrome-manganese steel, ground and balanced to assure smooth operation. Flat top threads are used on the spindle. The tool rests on the grinder are adjustable and removable. Lubrication is effected by means of oil reservoirs with convenient oil cup, oil level gage and drain plug for ease in flushing the bearing chamber.

The wheel guards are of approved design, made of boiler plate with hinged doors for convenience in changing grinding wheels. They are adjustable to compensate for the wear of grinding wheels and are fitted with chip breakers, eye shield and an exhaust connection.

An automatic motor starter with push button control is mounted on the inside of the pedestal door for convenience of inspection.

Hascrome Welding Rod

THE Haynes Stellite Company, Kokomo, Ind., has placed on the market a manganese-chrome-iron welding rod called Hascrome. This is a self-hardening alloy, designed primarily for building up badly worn parts preparatory to surfacing them with Haynes Stellite, which is also supplied in the form of welding rod. Since the cost of Hascrome is materially less than that of Haynes Stellite, the resulting composite surface is much cheaper than if entirely built up of the latter alloy. Hascrome may be used for building up large sections of steel or cast iron. It forms a good base for Stellite because it is sufficiently hard to resist deformation under impact, and because of the ease with which Stellite flows onto it. Although in some cases Hascrome may be used alone for hard-surfacing parts subject to abrasive wear, it does not possess hardness to the same degree as Stellite, and it will wear off more rapidly.

The oxy-acetylene process is considered best for the application of Hascrome, since the hardness of the deposited metal can be controlled by the amount of excess acetylene used in the welding flame, as well as by the rate of cooling. The greater the excess of acetylene in the flame and the slower the cooling rate, the harder the deposit will be. When quenched, the metal becomes softer and tougher. Best results are obtained if the deposit is made when the steel surface is at a "sweating" heat. The following figures are given by the manufacturers as results obtained under average conditions:

Small Excess of Acetylene	Brinell hardness
Slowly cooled	250—300
Quenched	240—290
Heavy Excess of Acetylene	
Slowly cooled	450—500
Quenched	350—450

The Hascrome deposit is said to have a tensile strength of 40,000 lb. and a compression strength of 177,000 lb. per sq. in. It can be forged and ground, but not machined.

Hascrome welding rod can also be applied by means of the metallic arc process, by the use of reverse polarity, making the rod the positive electrode. Care must be taken to prevent cracking after quenching when this method is employed. Arc-welded deposits have a hardness of 240 to 400 Brinell, depending on the rate of cooling. Better deposits are obtained when a coated rod is used. An excellent coating can be made as follows: Calcium carbonate, 1 oz.; silica flour, 1 oz.; sodium bicarbonate, 1 oz.; shellac, 1 oz., and alcohol, 16 oz. Hascrome is available in welding rods ¼ in. in diameter and 36 in. long, packed in bundles of 50 lb. each.

Triple-Valve Cylinder Truing Tool

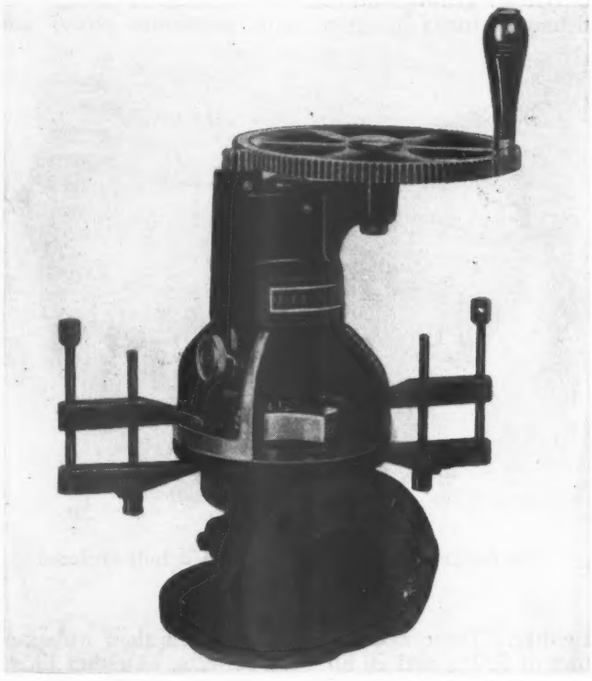
A TOOL designed for truing the worn cylinders of triple valves and distributing valves has been developed and placed on the market recently by the Owen D. Kinsey Company, Harvey, Ill. The OK triple tool, as it is called, is made in three sizes for 3½-in. valves, 4-in. valves and all 4¾-in. passenger valves. It is simple in design, easy to use, and is said to true worn cylinders many times with as little enlargement as .0005 in. per cut.

The OK triple tool centers mechanically by turning the micrometer dial located on the upper end of the spindle with a tee-head wrench provided for this purpose. When centering is completed in this manner, the size of the triple valve cylinder is indicated by the graduations on the dial and if within limits, the base of the tool is then securely clamped to the flange of the triple or distributing valve as the case may be. An improvement has been made in the clamping facilities illustrated, the clamps being now replaced by a clamping mechanism incorporated in the base of the tool.

Next the tool or spindle head is collapsed and raised, and a small tool bit is swung into cutting position. Sensitive contact with the cylinder is accomplished by holding the spindle head with the fingers as the tool is expanded to the contact desired.

Truing is then accomplished by turning the hand wheel which, through gearing, increases the speed of the spindle at a ratio of 3 turns to 1, and a downward feed movement is also produced by a differential action in the gearing which feeds the tool with a fine even feed of approximately five-thousandths of an inch per revolution of the spindle or about one sixty-fourth of an inch to each turn of the hand wheel.

When truing is completed, the tool is collapsed and raised by rapid movement which is provided for that purpose.

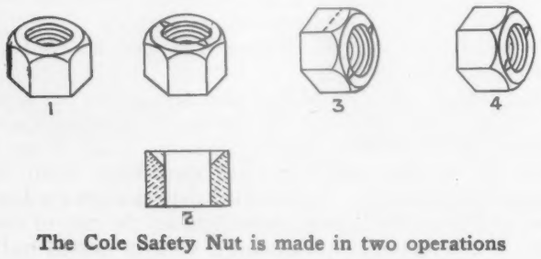


OK triple-valve-cylinder truing tool

A One-Piece Nut with Grip Lock

EDWARD J. Cole, 945 Paulding street, Peekskill, N. Y., has invented and patented a one-piece standard nut with a grip-locking feature. The nuts are made from standard blanks and are designed to be used in lieu of lock washers, double nuts, castle nuts, etc. They can be removed and replaced repeatedly without impairing their efficiency as lock nuts.

The sequence of operations in the manufacture of this nut are shown in the drawing. Fig. 1 is a blank nut. Two V-shaped grooves are cut in the top of the blank, as shown in Fig. 2 of the drawing, 2½ threads deep. The nut is then tapped in the usual manner, after which it is placed in a small power press which closes that portion of the nut above the dotted line shown in Fig. 3. The grooves are closed from .005 in. to .0008 in. sufficient to distort the threads and to set up a spring tension after the nut is applied to the bolt.



The Cole Safety Nut is made in two operations

It is reported that satisfactory tests of this nut have been made in machine-tool applications and on shop equipment which operates under considerable vibration.

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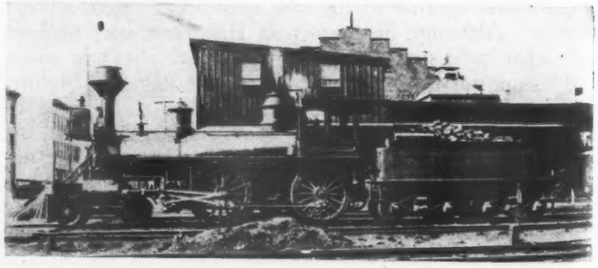
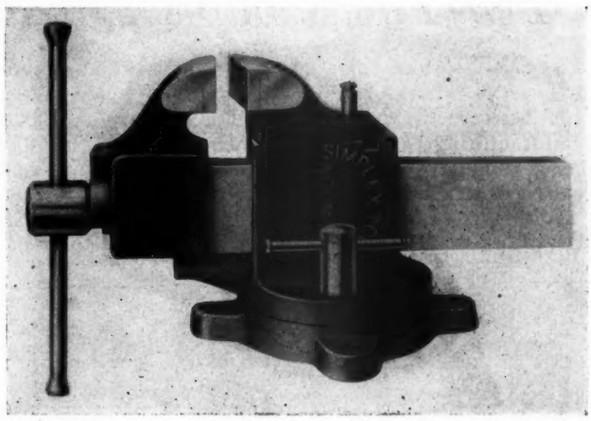


New York & Greenwood Lake 4-4-0 type locomotive No. 7 "Eagle Rock" built by Rogers

Simplex Swivel-Back Jaw Vise

THE Simplex Tool Company, Woonsocket, R. I., has recently placed on the market a swivel-back jaw vise, shown in the illustration. The back of this vise is made in two parts. The top part swivels, which feature is intended to be used when holding irregular pieces. This part of the vise is provided with a pin which is used for locking it to the rear jaw when the swivel feature is not desired.

This vise is made with the sliding member of the front jaw machined from a solid bar, which tends to eliminate the possibility of breakage at the point where vise failures frequently occur. It has a special type nut which threads over the operating screw and is so designed that it cannot lift at the back and bind the screw. When a strain of this nature occurs in a vise, it not only limits gripping power, but there is a possibility of the screw or nut failing. The vise has the outside screw retainer and removable jaw inserts which are both doweled and secured with screws.

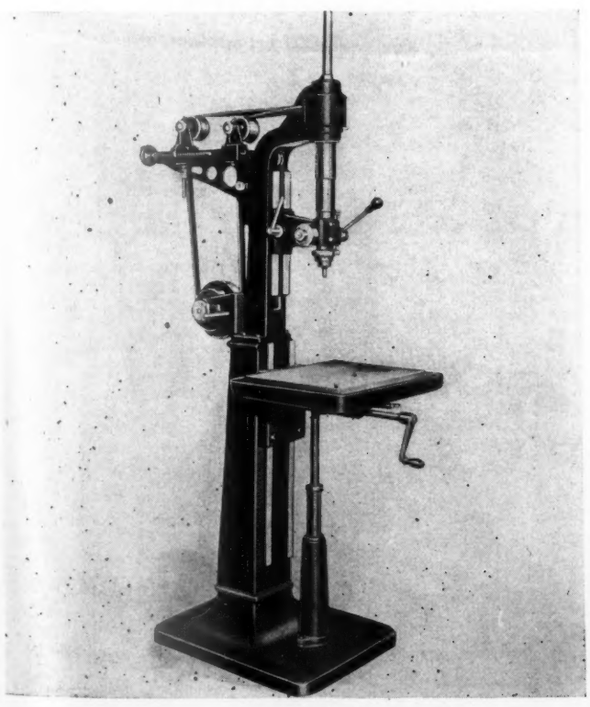


Vise designed to hold pieces of regular and irregular shapes

Buffalo 14-in. Hi-Speed Drills

THE Buffalo Forge Company, Buffalo, N. Y., has recently placed on the market a type of 14-in. single-spindle high-speed drill which may be obtained in either a bench or a floor model. These machines are equipped throughout with ball bearings and may be arranged for either belt pulley or motor drive. In the bench type machine the working surface of the table is 14 in. by 14 in. and the maximum distance from the drill chuck to the table is 11 in. The height of the machine is 44 in. In the pedestal type the machine is 81 in. high, has a table with a working surface 18 in. by 14 in. and a maximum distance from the table to the chuck of 30 in. The chuck will handle drills up to and including ½ in. in diameter and when the machine is equipped with a ½-hp. motor operating at 1,750 r. p. m. with 6-in. and 8-in. drive pulleys, spindle speeds from 3,000 to 9,300 r. p. m. may be obtained. This combination of speeds is suitable for drills of ⅛-in. maximum diameter in soft steel and ¼-in. maximum diameter in brass. The same motor, with 3-in. and 5-in. drive pulleys will give speeds from 1,500 r.p.m. to 5,800 r.p.m. and will permit drilling in soft steel with $\frac{5}{16}$-in. drills and, in brass, with $\frac{7}{16}$-in. drills. A motor operating at 850 r. p. m. with 3-in. and 5-in. drive pulleys will provide spindle speeds from 750 to 2,900 r. p. m. and will drive a ½-in. diameter drill in soft steel. The travel of the spindle is 3½-in. within the head and the vertical adjustment of the sliding head is 7¼-in.

The bench type machine weighs about 260 lb. and the pedestal type about 500 lb. The pedestal type is shown in the illustration.



Pedestal type Buffalo high-speed drill—This model may also be obtained in a bench type

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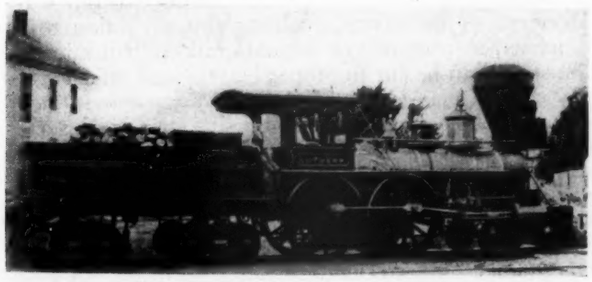
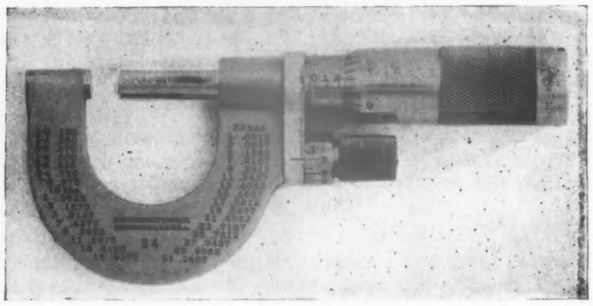


Rome, Watertown & Ogdensburgh 4-4-0 type locomotive No. 17 "Antwerp"—Built in the shops of the railroad company

Micrometer Reads Ten-Thousandths Direct

A NEW principle in measuring to ten-thousandths of an inch is employed in the micrometer caliper No. 24 recently announced by the Brown & Sharpe Manufacturing Company, Providence, R. I. This tool has a range from 0 to 1 in. by ten-thousandths, and reads the ten-thousandth parts of an inch directly.

With this caliper the thousandths are read from the barrel and thimble in the regular manner and the readings in ten-thousandths of an inch are read directly from the small lower thimble. The widely spaced graduations permit parts of ten-thousandths to be estimated.



The No. 24 micrometer caliper—Ten-thousandths are read from the small thimble

This caliper is used and operated in much the same way as the conventional 1-in. micrometer. After the spindle has been brought up to the object to be measured, the small lower thimble is turned until the horizontal line on the barrel of the micrometer coincides with a graduation on the main thimble. The graduation on the small lower thimble then tells the ten-thousandths of an inch to be added to the thousandths reading. The No. 24 caliper is of simple construction and has no gears or intricate parts to get out of order.

Buffer with Renewable Abrasive Strips

A BUFFING wheel recently developed by C. B. Hunt & Son, Salem, Ohio, entails the use of abrasive strips and contains a special feature for quick replacement of the strips, enabling this operation to be completed in a matter of seconds rather than minutes. The strips can be cut to proper lengths and attached, or they can be secured already bound by a patented metal clip. The clipped ends of the abrasive strip are inserted into the gap in the rubber face of the wheel and down into a slot. The strip is then folded over the wheel and quickly and tightly locked in place by the use of a special wrench.

The sides of the wheel are heavy-gage steel stampings pressed onto a heavy circular steel drum. A thick rubber face is cured onto this drum. The attachment of the wheel to any stationary or portable spindle is simply a matter of tightening a nut. The entire assembly is accurately balanced so that the wheel runs true and bears evenly against the object being cleaned or polished. The wheels do not require removal from the spindle to renew the buffing surface.

The wheels are tested at 8,000 r.p.m. The most efficient range for buffing with this wheel is between 3,500 and 4,500 r.p.m. During operation the full width of the abrasive strip is brought into use on any flat open surface.

The abrasive strip is easily replaced, a small wrench being the only tool required

These buffing wheels are manufactured in two sizes, 6 in. and 8 in. diameter. Both sizes are made with 2½- and 3½-in. faces and arbor sizes of ½ in. to 2 in. Speeds recommended are 3,450 to 5,000 r.p.m. From 24- to 320-grain abrasive strips can be applied.

* * *

A scene along the Erie

News of the Month

A HEARING was held recently before Special Examiner Rogers of the Interstate Commerce Commission on a complaint filed by the train service brotherhoods asking a modification of the commission's regulations which prescribe wooden running boards on box cars. The brotherhood would permit the use of "other material suitable to afford secure footing." It was indicated at the hearing that both the railroads and the brotherhoods would be satisfied with a permissive amendment to the regulations which would permit the use of running boards of composition or other material than wood.

Clubs and Associations

THE AMERICAN SOCIETY FOR TESTING MATERIALS has selected Atlantic City, N. J., as the location for its 1930 annual meeting, which will be held at Haddon Hall on June 23-27. The executive committee has also decided that the 1931 meeting will be held at the Hotel Stevens, Chicago, on June 22-26.

PURDUE UNIVERSITY held its fifth annual conference on welding at Lafayette, Ind., December 11, 12 and 13. This three-day conference was under the joint direction of the Engineering Extension Department and the Department of Practical Mechanics and was devoted to lectures, demonstrations and exhibits of welding methods and equipment.

PAUL D. MALLAY, chief engineer, Transportation Department, of the Johns-Manville Corporation, 292 Madison avenue, New York, has been appointed secretary of the Railroad Division of the American Society of Mechanical Engineers, succeeding Marion B. Richardson, associate editor of the *Railway Mechanical Engineer,* who has resigned.

The following list gives name of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York. Next meeting, Minneapolis, Minn.

AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual convention June 18-25, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting, Sept. 9-11, 1930, Chicago.

DIVISION VI—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Annual convention June, 1930, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division—Paul D. Mallay, chief engineer transportation department, Johns-Manville Corporation, 292 Madison avenue, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting Atlantic City, N. J., June 23-27.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMAN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 7836 So. Morgan street, Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago. Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eight St., Los Angeles, Cal. Meetings second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Weigman, 720 North Twenty-third street, East St. Louis, Ill. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CENTRAL RAILWAY CLUB.—Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTOR'S AND CAR FOREMEN'S ASSOCIATION.—See Master Car Builders' and Supervisors' Ass'n.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati, Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting September, 1930, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. T. Winkles, Room 707, LaSalle Street Station, Chicago. Next meeting May 6-9, 1930 Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKER'S ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood St., Albany, N. Y. Annual meeting May 21-24 William Fenn Hotel, Pittsburgh, Pa.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September. Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Mrs. M. E. Hartman, acting secretary, 26 Cortlandt street, New York. Next meeting December 12, 6:15 p. m. Fifty-seventh annual dinner.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—See Master Car Builders' and Supervisors' Association.

RAILWAY CLUB OF GREENEVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greeneville, Pa. Meetings third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Ft. Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24 St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Master Car Builders' & Supervisors' Association.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Next meeting September 23-26, 1930, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

THE ACME STEEL COMPANY, Glassmere, Pa., manufacturers of electric steel castings, is making additions to its foundry buildings and installing additional machinery.

A MERGER has been effected by the Oster Manufacturing Company, Cleveland, Ohio, and the Williams Tool Corporation, Erie, Pa. This merger brings under one operating head the manufacture and marketing of a complete line of die stocks and power pipe threading machines.

CRAWFORD MCGINNIS, representing the Pyle-National Company, Chicago, has opened a new office for that company in the Transportation building, Washington, D. C.

J. E. FREEMAN, formerly manager of the Par-lock Appliers, Chicago, has been elected vice-president of the Tnemec Paint & Oil Company, with headquarters at 205 W. Wacker Drive, Chicago.

THE MURRY JACOBS COMPANY, 544 South Pedro street, Los Angeles, Cal., now represents the Reading Chain & Block Corporation in southern California. Harry T. Lynam is in charge of the Los Angeles office.

GEORGE A. MIDWOOD, JR., has been appointed treasurer of the Bicknell-Thomas Company of Greenfield, Mass. Mr. Midwood was formerly sales manager of the D. E. Whiton Machine Company, New London, Conn.

THE FATE-ROOT-HEATH COMPANY, Plymouth, Ohio, has recently completed a new factory unit of steel and brick construction. New equipment which is now being installed will enable this company to double its present output of gasoline and Diesel locomotives.

THE P. & C. COMPANY, Chicago, has been organized to sell railway and industrial supplies by Walter R. Pflasterer, formerly manager of railroad sales of the United States Graphite Company, and Roy N. Chissom, manager of railroad sales of the Otley Paint Company.

FRANK P. WALSH has been appointed manager of the newly opened district office of the Whiting Corporation, 1442 Syndicate Trust building, St. Louis, Mo. Mr. Walsh will have charge of this company's sales in a territory comprising Missouri, Arkansas and Oklahoma, Southern Illinois and western Iowa and Nebraska.

FRANK DUSTAN and O. B. Schmeltz, sales engineers, formerly located at the Putnam Machine Works, Fitchburg, Mass., have been transferred to Pittsburgh, Pa., to assist the Arch Machinery Company in representing Putnam machine tools of Manning, Maxwell & Moore, Inc. Their headquarters are in the Park building, Pittsburgh.

GORDON THORNTON has recently joined the Cleveland staff of the United States Electrical Tool Company. Ralph H. Clore, branch sales manager at Cincinnati, Ohio, has been appointed general sales manager, succeeding George M. Lawrence, who resigned to become vice-president of the General Radial Drill Company, Cincinnati.

J. W. CAIN, manager of purchases of the American Short Line Railroad Association, with headquarters at Houston, Tex., has resigned to devote his entire time to the presidency of the San Diego & Gulf and the Duval Texas Sulphur Company, and the Consolidated Purchasing Agency of the Short Line Association will be discontinued on that date.

L. A. HOPKINS, president of Hopkins-Benedict Company, Chicago, has sold his interest in this company to his brother, C. C. Hopkins, who is now president and sole owner of the company. This firm acts as the railroad sales division of the Sisalkraft Company and district sales agents for the Boss Bolt & Nut Company, besides handling a varied line of railroad supplies.

F. B. FARMER, representative of the Westinghouse Air Brake Company at St. Paul, Minn., has been appointed assistant to the director of engineering. C. J. Werlich, mechanical expert in the same office, has been promoted to representative, succeeding Mr. Farmer. V. Villette has been appointed Pacific manager of the company at San Francisco, Cal., succeeding the late H. S. Clark, and V. B. Emerick, formerly of the Locomotive Stoker Company, has been appointed mechanical expert at the St. Paul office.

JOSEPH P. FLETCHER, manager of the Buffalo office of the Independent Pneumatic Tool Company, has been appointed manager of the Philadelphia office of this company, to succeed the late A. L. Schuhl, who died on October 20. W. O. Becker, who has been connected with the Toronto office, has been named manager of the Buffalo office to succeed Mr. Fletcher.

ADOLPH F. STARK, vice-president of the Economy Arch Company, St. Louis, Mo., died suddenly of heart disease at Topeka, Kan., on October 22. Mr. Stark served an apprenticeship as a machinist and worked at this trade in many parts of the United States. In 1917 he became associated with the Locomotive Pulverized Fuel Company as service expert, continuing in this capacity with that company and its successor, the Combustion Engineering Corporation, until 1921, when he became vice-president of the Economy Equipment Corporation. He continued in that position until 1927 and since that time served as vice-president of the Economy Arch Company.

JAMES A. FARRELL, president of the United States Steel Corporation, and E. G. Grace, president of the Bethlehem Steel Corporation, have announced that the suits recently brought by Bethlehem Steel Company against the United States Steel Corporation and certain of its subsidiaries involving an alleged infringement of patents covering the manufacture and sale of broad flange sections have been settled under an arrangement by which the United States Steel Corporation and its subsidiaries have been licensed to manufacture and sell such sections under the Bethlehem patents for the remainder of their terms—from 12 to 16 years. The suits are to be discontinued.

L. S. CARROLL, vice-president in charge of purchases of the American Locomotive Company, died on November 14 in a subway train while on his way to his office in New York. He was born at Hemlock Lake, N. Y., and entered the service of the Chicago & North Western in 1886 as a helper at a station in Dakota. Mr. Carroll learned telegraphy and subsequently served as operator and station agent. He was later transferred to the accounting department in Chicago where he served consecutively as traveling auditor and general traveling auditor until his appointment in 1901 as purchasing agent. He subsequently served as general purchasing agent for both the Chicago & North Western and the Chicago, St. Paul, Minneapolis & Omaha. During the government operation of the railroads he was chairman of the Northwestern Regional Purchasing Committee and when the railroads were returned to their owners, Mr. Carroll on March 1, 1920, entered the service of the American Locomotive Company as general purchasing agent. Since May, 1924, he had served as vice-president in charge of purchases.

L. S. Carroll

ARTHUR LEGRAND DOTY, vice-president of the Middletown Car Company, died at the Hudson City Hospital, Hudson, N. Y., on November 18, following an operation. Mr. Doty was born on July 21, 1871, at Newark, N. J. He prepared for college at the Newark Academy, and graduated from Princeton University in 1892. He was for many years in the railroad equipment export business, particularly with South America. Later he served as vice-president in charge of its foreign activities of the Middletown Car Company, with headquarters at Paris. During the World War Mr. Doty rendered important service in

charge of the erection of cars shipped overseas for use of the French and American armies. He also supervised transportation of heavy munitions shipments for the Allied armies.

CHARLES BREARLEY MOORE, president of the Ajax Hand Brake Company, Chicago, chairman of the board of the Oxweld Railroad Service Company and vice-president of the Youngstown Steel Door Company, died in Evanston, Ill., on November 9, from an illness that had been lingering since June. He was born at Macomb, Ill., on August 28, 1874, and graduated from Lake Forest University, Lake Forest, Ill., in 1895. In that year he entered the contracting and building business under the firm name of C. B. Moore & Co., and some time later engaged in the manufacture of heating apparatus with the Columbia Heating Company. In January, 1902, he joined in the organization of the American Locomotive Equipment Company, of which he was general manager until 1910. At that time he organized the American Arch Company of New York and served as vice-president until 1912, when he assisted in the organization of the Oxweld Railroad Service Company, occupying the position of vice-president until November, 1929, when he was elected chairman of the board. From 1912 to 1917 he was also vice-president of the Boss Nut Company. In 1922 he organized the Ajax Hand Brake Company, of which he was president at the time of his death. He was vice-president of the National Car Equipment Company and president of the American Steel Door Company, which was organized in 1923. He had been vice-president of the Youngstown Steel Door Company since 1924.

C. B. Moore

JOSEPH T. RYERSON & SON, INC., have purchased the business equipment and stock of the Penn-Jersey Steel Company, Camden, N. J. This firm carries stocks of steel shapes, plates, sheets, hot and cold finished bars, reinforcing bars, etc., and serves all industry and construction trades in the Philadelphia district. The Ryerson Company plans to add to the stock and increase the facilities.

THE LAKE ERIE BOLT & NUT COMPANY and the Lamson & Sessions Company, bolt manufacturers located at Cleveland, Ohio, have been consolidated and will now be operated under the name of the Lamson Sessions Company. George S. Case has been elected president. N. J. Clarke has been appointed vice-president and chairman of the Executive Committee; I. L. Jennings, vice-president and director of sales and Herbert P. Ladds, assistant sales manager.

DRAFT GEAR SPECIFICATIONS.—The Waugh Equipment Company, Depew, N. Y., has reprinted in a booklet entitled "O. K." the Tentative Specifications for Draft Gears for Freight Cars as set up by the Committee on Couplers and Draft Gears, American Railway Association, and has extracted below each specification the draft gear characteristics it sets forth. Following this reprint is a comparative chart, in one column of which is listed the page, chart or figure numbers in the report of the committee which show just how the Waugh-Gould draft gear measures up to the committee's specifications. Several blank columns are also provided on the chart for use in recording similar data for other types of draft gears which one may wish to compare with the specifications.

Personal Mention

General

F. S. BROWN, mechanical engineer of the Erie, with headquarters at Cleveland, Ohio, has been transferred in a similar capacity to New York.

H. A. BOYER, assistant shop superintendent of the Erie, with headquarters at Hornell, N. Y., has been transferred to the mechanical department at New York.

AUGUSTIN C. RUIZ has been assigned to the position of traveling inspector for the mechanical department of the National of Mexico, with headquarters at Mexico, D. F.

C. W. ESCH, chief draftsman in the mechanical department of the Chicago & Alton, has been appointed mechanical engineer, with headquarters at Bloomington, Ill., succeeding G. C. Seidel, resigned.

G. A. SCHNEIDER, master mechanic of the Schuylkill and Sunbury divisions of the Pennsylvania, has been promoted to the position of inspector, in the office of the general superintendent of motive power at Philadelphia, Pa.

A. G. TRUMBULL, chief mechanical engineer of the Erie, has been apointed chief mechanical engineer of an advisory mechanical committee consisting of the chief mechanical officer of each of the following roads: Chesapeake & Ohio; the Erie; Hocking Valley; New York, Chicago & St. Louis, and Pere Marquette. This committee will act in an advisory capacity in all matters relating to the design of new rolling equipment to be acquired by the above-mentioned roads. Mr. Trumbull will have supervision over the mechanical engineering forces for the advisory mechanical committee, with headquarters at Cleveland, Ohio. Mr. Trumbull was born at Hornell, N. Y., and is a graduate in mechanical engineering, Cornell University, 1899. He became engineer of tests on the Erie in 1902; mechanical engineer in 1903; assistant mechanical superintendent at Meadville, Pa., in 1905; assistant mechanical superintendent, Ohio division, in 1907; mechanical superintendent, Ohio division and Chicago & Erie, in 1907; mechanical superintendent, Erie Division, in 1912; assistant to general mechanical superintendent in 1914; assistant general mechanical superintendent in 1919; mechanical superintendent, Ohio region, in 1920, and chief mechanical engineer in 1922. In 1920 Mr. Trumbull was appointed chairman of the Committee on Modernization of Stationary Boiler Plants, Mechanical Division, A.R.A., and from 1925 until 1928 served as chairman of the Tank Car Committee. For the past three years he has been a member of the General Committee, Mechanical Division. He joined the American Society of Mechanical Engineers in 1927 and is now serving as a member of the Executive Committee of the Railroad Division.

A. G. Trumbull

H. P. ALLSTRAND, who has been promoted to principal assistant superintendent of motive power and machinery of the Chicago & North Western, with headquarters at Chicago, has been connected with the mechanical department of that railway for more than 26 years. He was born in Council Bluffs, Iowa, September 8, 1885, was graduated from the Missouri Valley, Iowa, high school in 1903, and entered the service of the Northwestern as a machinist apprentice at the latter point on June 2 of that year. Following the completion of his apprenticeship Mr. Allstrand served for two years as a machinist and as a gang foreman at Missouri Valley, then entering Iowa State College in 1909, from which he was graduated in mechanical engineering in 1913. He then returned to the Northwestern and for the following 11 years served successively as enginehouse foreman at East Clinton, Ill., at South Pekin and at Chicago, as assistant master mechanic at Chadron, Neb., and as master mechanic at Eagle Grove, Iowa, Belle Plaine and Boone. In 1924 Mr. Allstrand was appointed efficiency supervisor in the mechanical department, with headquarters at Chicago, and in 1927 he was promoted to assistant superintendent of motive power and machinery, with headquarters at the same point.

H. P. Allstrand

Shop and Enginehouse

R. D. DUVANT, assistant night enginehouse foreman of the Louisville & Nashville at Mobile, Ala., has been promoted to the position of night enginehouse foreman.

J. C. THOMAS, night enginehouse foreman of the St. Louis-San Francisco at Tulsa, Okla., has been promoted to the position of day enginehouse foreman.

JOHN C. SNYDER, JR., acting gang foreman of blacksmiths of the Pennsylvania at Lucknow, Pa., has been promoted to the position of gang foreman, with headquarters at Lucknow.

J. C. FINCH has been promoted to the position of assistant night enginehouse foreman of the St. Louis-San Francisco, with headquarters at Tulsa, Okla.

C. L. NUMMY, general foreman of the Texas & Pacific at Baird, Tex., has been transferred to Texarkana, Ark., as general foreman, locomotive department, at that point.

T. L. HARTSOCK, foreman at the Tyrone, Pa., enginehouse of the Pennsylvania, has been promoted to the position of second assistant enginehouse foreman, *C* trick, with headquarters at the Harrisburg, Pa., enginehouse.

G. W. KERN, general foreman of the locomotive department of the Union Pacific at Kansas City, Kan., has been promoted to the position of district foreman, with headquarters at Junction City, Kans.

E. C. ROTH, gang foreman of the Pennsylvania at Dennison, Ohio, has been promoted to the position of gang foreman, first trick, inspection pit, with headquarters at the Harrisburg, Pa., enginehouse.

JOHN C. SNYDER, JR., acting gang foreman of blacksmiths at Lucknow, Pa., has been promoted to the position of gang foreman, with headquarters at Lucknow.

H. W. KUNES, pipefitter at the Renovo, Pa., shops of the Pennsylvania, has been promoted to the position of gang foreman, second trick, with headquarters at the Meadows, N. J., enginehouse.

W. J. THOMAS, night enginehouse foreman of the Louisville & Nashville at New Orleans, La., has been promoted to the position of day enginehouse foreman, succeeding W. S. Farrell, deceased.

R. E. BOHON, enginehouse foreman of the St. Louis-San Francisco at Tulsa, Okla., has been promoted to the position of general foreman, locomotive department, with headquarters in the same city.

G. M. JESSEE, assistant enginehouse foreman of the St. Louis-San Francisco at Tulsa, Okla., has been promoted to the position of general enginehouse foreman, with headquarters in the same city.

W. J. BARLOW, supervisor of apprentices of the Kansas City Southern at Pittsburgh, Kans., has been promoted to the position of general foreman, locomotive department, with headquarters at Shreveport, La.

Master Mechanics and Road Foremen

SANTOS FIERRO has been appointed master mechanic of the National of Mexico, with headquarters at Monclova, Coah.

GUSTAVO ALVARADO has been appointed master mechanic of the National of Mexico, with headquarters at Cardenas, S. L. P.

S. J. STARK, master mechanic of the International Great Northern, has been transferred to Kingsville, Tex., as master mechanic of the Gulf Coast Lines.

H. D. CARPENTER, assistant master mechanic of the Akron division of the Pennsylvania, has been appointed master mechanic of the Philadelphia division.

A. W. SUMNER, assigned to special duty in the office of the chief of motive power of the Pennsylvania, has been appointed assistant master mechanic of the Akron division.

J. I. COFFEY, mechanical foreman of the Chesapeake Beach Railway, has been appointed master mechanic, with headquarters at Washington, D. C.

C. K. STEINS, master mechanic of the Pennsylvania at Indianapolis, Ind., has been appointed master mechanic, with headquarters at Wilmington, Del.

G. J. RICHERS, master mechanic of the Elmira division of the Pennsylvania, has been appointed master mechanic of the Schuylkill and Sunbury divisions.

CHARLES EMERSON, acting master mechanic of the Tacoma division of the Northern Pacific, with headquarters at Tacoma, Wash., has been promoted to master mechanic of the division. Mr. Emerson succeeds James Bruce, who retired on November 15 after more than 46 years of continuous service with the Northern Pacific.

F. A. Weatherford, who has been appointed master mechanic of the Seaboard Air Line, with headquarters at Savannah, Ga., was born on September 12, 1888, at Florence, S. C. He re-

ceived a high-school education, also training through the International Correspondence Schools. He entered railway service in 1902, as a machinist apprentice on the Atlantic Coast Line. On October 10, 1907, he became a machinist on the Seaboard Air Line; on December 16, 1924, was promoted to the position of erecting shop foreman at Andrews, and on April 23, 1928, appointed mechanical foreman at Charleston, S. C. On July 11, 1928, Mr. Weatherford was transferred to Bainbridge, Ga., where he served as general foreman until his appointment as master mechanic with headquarters at Savannah.

Car Department

H. E. LUNDFELT, car repairman, has been promoted to the position of gang foreman, car department, of the Pennsylvania at Renovo, Pa.

E. J. MAYER, car repairman, has been promoted to the position of gang foreman at the Wilmington, Del., car erecting shop of the Pennsylvania.

MAX REUM has been appointed general car foreman of the Michigan Central, with headquarters at Niles, Mich., succeeding J. J. Nicol.

J. E. WELCH, general car foreman of the Missouri Pacific at St. Louis, Mo., has been appointed general car foreman, with headquarters at Kansas City, Mo.

W. C. SEARS, general car foreman of the Wabash at Moberly, Mo., has been appointed general car foreman, with headquarters at Kansas City, Mo.

R. H. CRUSE, gang foreman at the eastbound repair shop of the Pennsylvania at Altoona, Pa., has been promoted to the position of assistant foreman, Lucknow car shop.

C. HOPKINS, formerly a carman in the employ of the Missouri Pacific at Gundon, Ark., has been transferred to Van Buren, Ark., as an A. R. A. checker at that point.

W. L. JONES has been appointed air brake, lubrication and car heating engineer of the Illinois Central, with headquarters at Memphis, Tenn., succeeding T. W. Kennedy.

J. J. NICOL, general car foreman of the Michigan Central at Niles, Mich., has been appointed division general car foreman at St. Thomas, Ont., succeeding A. J. Mitchener, deceased.

J. E. HORNBACH, car foreman of the Missouri-Kansas-Texas at Muskogee, Okla., has been promoted to the position of general car foreman, with headquarters at Oklahoma City, Okla.

A. M. DOW, car foreman of the Missouri Pacific at Gundon, Ark., has been appointed general car foreman of the St. Louis-San Francisco, with headquarters at Oklahoma City, Okla.

E. L. PHELPS, car foreman of the St. Louis-San Francisco at Oklahoma City, Okla., has been appointed general car foreman, with headquarters at West Tulsa, Okla., to succeed J. S. Jowers, resigned.

T. W. KENNEDY has been appointed air brake and car heating instructor of the Illinois Central, succeeding F. H. Hinton, who has been relieved at his own request. Mr. Kennedy has charge of air brake instruction cars 6 and 10.

A. ROUTON, A. R. R. checker in the employ of the Texas & Pacific at Texarkana, Ark., has been promoted to the position of assistant car foreman, with headquarters at the same point.

J. N. DAVIS, master carpenter of the Tyrone division of the Pennsylvania, has been appointed master carpenter of the Cumberland Valley division.

G. C. CHRISTY, who has been appointed superintendent of the car department of the Illinois Central, with headquarters at Chicago, has been connected with that road for more than 31 years. He was born at Water Valley, Miss., in 1884 and entered railroad service as a painter apprentice on the Illinois Central at that point in 1898. Two years later he was transferred to the mechanical department and upon the completion of his apprenticeship in March, 1904, he served until 1911 as a machinist and a foreman. In October of the latter year he was advanced to general foreman at Water Valley, then being transferred to McComb, Miss., in December, 1914. Mr. Christy was promoted to master mechanic of the Greenville and New Orleans divisions at Vicksburg, Miss., in July, 1917, and in 1926 his jurisdiction was extended to include the Vicksburg Route division. His promotion to superintendent of the car department became effective on November 1.

G. C. Christy

CHARLES J. WYMER, who has been placed in charge of the car department of the Chicago & Eastern Illinois, with the title of superintendent of the car department and with headquarters at Danville, Ill., was born at Jane Lew, W. Va., on July 8, 1870. After attending the State Normal School at Fairmont, W. Va., for two years, he entered railway service in 1891 as freight agent for the West Virginia & Pittsburgh (now part of the Baltimore & Ohio) at Sutton, W. Va. From 1892 to 1907 Mr. Wymer served successively with a construction company on the construction of the West Virginia & Pittsburgh from Flatwoods, W. Va., to Camden-on-Gauley; as ticket agent and manager of the telegraph office of that road at Weston, W. Va.; on construction work in railroad building in Oklahoma; in the mechanical department of the Atchison, Topeka & Santa Fe at Raton, N. M., and as car foreman on that railway at Trinidad, Colo. He entered the service of the Chicago & Eastern Illinois on April 1, 1907, as chief clerk to the general car foreman at Danville and in the following year was promoted to general car inspector. In February, 1912, he was appointed general car foreman of the Belt Railway of Chicago and from 1916 to 1919 was connected with the Grip Nut Company at Chicago. In August, 1917, he was appointed superintendent of the car department of the C. & E. I., a position which, until the recent reorganization of the mechanical department, was under the jurisdiction of the superintendent of motive power. The office of superintendent of motive power has been abolished.

Charles J. Wymer

Purchases and Stores

JOHN E. MAHANEY, who has been appointed general supervisor of stores of the Chesapeake & Ohio, the Hocking Valley and the Pere Marquette, with headquarters at Cleveland, Ohio, has been connected with railway purchasing and stores departments, principally in the west, for 35 years. He was born at St. Paul, Minn., on December 23, 1875, and was educated in the public schools of that city. On November 22, 1894, he obtained his first railway experience as a counter boy in the general store department of the Minneapolis, St. Paul & Sault Ste. Marie. Five years later he became general foreman in the store department of the Eastern Minnesota (now part of the Great Northern) at West Superior, Wis. From 1901 to 1916 Mr. Mahaney served successively as storekeeper for the Soo line at Gladstone, Mich.; foreman in the stores department of the Chicago, Rock Island & Pacific at Chicago; storekeeper of the Southern Pacific at Sacramento, Cal.; general storekeeper of the Oregon-Washington Railroad & Navigation Company at Portland, Ore.; purchasing agent of the Spokane, Portland & Seattle, the Oregon Trunk, the Oregon Electric and the United Railways at Portland, and general storekeeper of the Norfolk & Southern at Berkley, Va. During 1918 and 1919 he acted as supervisor of stores of the Northwestern region of the United States Railroad Administration and he was then appointed general storekeeper of the Seaboard Air Line, with headquarters at Portsmouth, Va. Mr. Mahaney became superintendent of stores of the Chesapeake & Ohio, with headquarters at Richmond, Va., in May, 1921, holding this position until his promotion to general supervisor of stores of that road, the Hocking Valley and the Pere Marquette.

John E. Mahaney

GEORGE E. JOHNSON has been appointed storekeeper of the Boston & Albany, with headquarters at West Springfield, Mass.

ERNEST B. ROCKWOOD has been appointed general storekeeper of the Boston & Albany, with headquarters at West Springfield, Mass.

L. F. LOHMANN has been appointed assistant purchasing agent of the Great Northern, with headquarters at Seattle, Wash., succeeding O. H. Wood, deceased.

S. L. BOQUE, assistant district storekeeper of the Southern Pacific, at El Paso, Tex., has been appointed stores inspector, with headquarters at San Francisco, to succeed A. Schipper.

H. C. PEARCE, director of purchases and stores of the Chesapeake & Ohio, has been also appointed to a similar position for the Pere Marquette, with headquarters at Cleveland, Ohio.

MICHAEL L. SHEEHAN has been appointed material supervisor of the Boston & Albany at West Springfield, Mass., reporting to the general storekeeper.

T. E. MEEHAN, division storekeeper of the Gulf Coast Lines at Kingsville, Tex., has been transferred to DeQuincy, La., as division storekeeper at that point.

ELDRED L. CATES has been appointed division storekeeper of the Northern Pacific, with headquarters at Dilworth, Minn., succeeding M. O. Weber, who has resigned.

J. M. DAY, foreman of stores, at the district storehouse of the Southern Pacific at West Oakland, Cal., has been promoted to assistant district storekeeper, with headquarters at El Paso, Tex., to replace S. L. Boque.

A. SCHIPPER, stores inspector of the Southern Pacific, has been promoted to general inspector of stores and supply train service, with headquarters as before at San Francisco, succeeding J. C. Neph.

J. C. NEPH, general inspector of stores and supply train service of the Pacific Lines of the Southern Pacific, at San Francisco, Cal., has been appointed purchasing agent and general storekeeper of Pacific Transportation Securities, Inc., with headquarters at the same point.

Obituary

T. C. HOPKINS, division storekeeper of the International Great Northern at Houston, Tex., died on October 30.

O. H. WOOD, assistant purchasing agent of the Great Northern, with headquarters at Seattle, Wash., died in that city on October 25.

JOSEPH E. BRADY, formerly master mechanic at the Riverside shops of the Baltimore & Ohio at Baltimore, Md., died on September 11. Mr. Brady had been in the employ of the B. & O. since October 28, 1884.

R. W. BELL, retired general superintendent of motive power of the Illinois Central, who died on October 14, had been connected with that road for 41 years and had been in railway service somewhat longer. He was born at St. Mary, Ont., on October 22, 1865, and entered railway service as a machinist apprentice. Following the completion of his apprenticeship Mr. Bell served on the Great Northern and on the Northern Pacific as a machinist, on the former road as a locomotive fireman and on the Chicago, Burlington & Northern (now part of the Chicago, Burlington & Quincy) and the Wisconsin division of the Illinois Central as a locomotive engineman. After 11 years as an engineman on the Illinois Central Mr. Bell was advanced to traveling engineer of the St. Louis division in 1899, in which position he remained until the following year when he was appointed general foreman of the Kentucky division, with headquarters at Louisville, Ky. In 1901 he was promoted to master mechanic of the St. Louis division, with headquarters at East St. Louis, Ill., then being transferred to the Iowa division, with headquarters at Waterloo, Iowa, in 1903. In 1908 he was further promoted to assistant superintendent of machinery, with headquarters at Chicago, and in the following year he became superintendent of machinery. Mr. Bell was promoted to general superintendent of motive power of the Illinois Central at Chicago on July 1, 1913.

R. W. Bell

Transportation Library

Railway Mechanical Engineer

FOUNDED IN 1832

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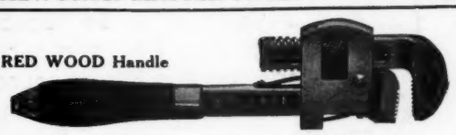
DEC 16 1929

The Walworth Master Stillson
Comes Through on the Job

WALWORTH MASTER STILLSON WRENCHES

RED WOOD Handle



RED STEEL Handle

Hardened and toughened by Walworth's Pyrochron process, the new Master Stillson is 50% stronger than even the famous old Walworth Stillson. You'll know it by the red handle.

With steel handles in sizes 6 to 48 inches.
With wood handles in sizes 6 to 14 inches.

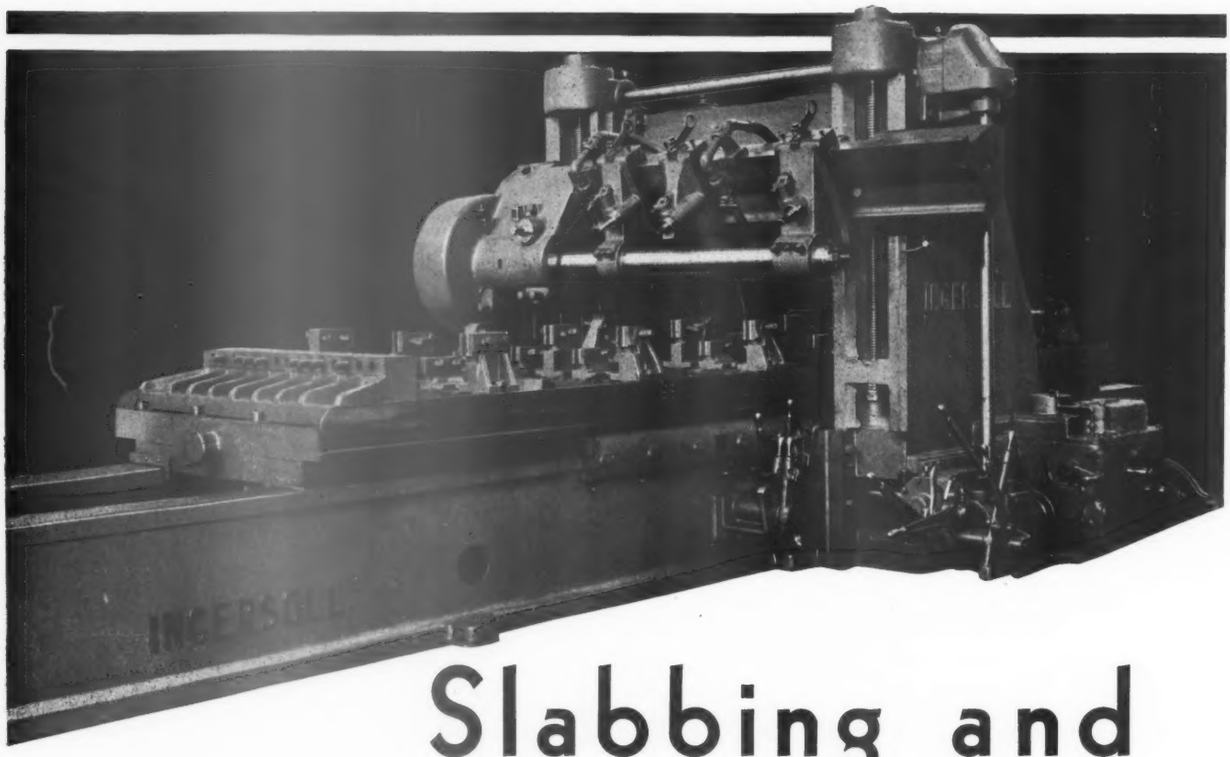
For 60 years the Standard Railroad Wrench

Walworth Company, General Sales Offices: 51 East 42nd St., New York
Plants at Boston, Mass.; Kewanee, Ill.; Greensburg, Pa.; and Attalla, Ala.

. . . *Distributors in Principal Cities of the World* . . .

Walworth Company Limited, 620 Cathcart St., Montreal, P. Q.
Walworth International Co., New York, Foreign Representative

December 1929



Slabbing and Channeling Rods...

The power and ruggedness of the heavy Ingersoll Horizontal Spindle Milling Machine make possible the use of very heavy cuts and high feeds on such work as slabbing, edging, and channeling locomotive rods.

The machine shown here is 54 inches wide and 16 feet long, driven by a 75 horsepower motor. It is equipped with Ingersoll universal fixtures which greatly increase the efficiency of the machine, both by cutting down loading time, and also by giving greater support for the heaviest cuts. This machine holds two of the largest rods for slabbing or channeling. Smaller machines of the same type, holding one big rod or two smaller ones, are built for shops that do not have such heavy rod work.

Other Ingersoll machines and equipment are built for rod ending and contour milling, milling driving boxes, shoes and wedges, and other operations found in locomotive shops. They are described in Bulletin No. 46 "Ingersoll Equipment for Railroad Shops." Write for a copy.

The Ingersoll Milling Machine Company

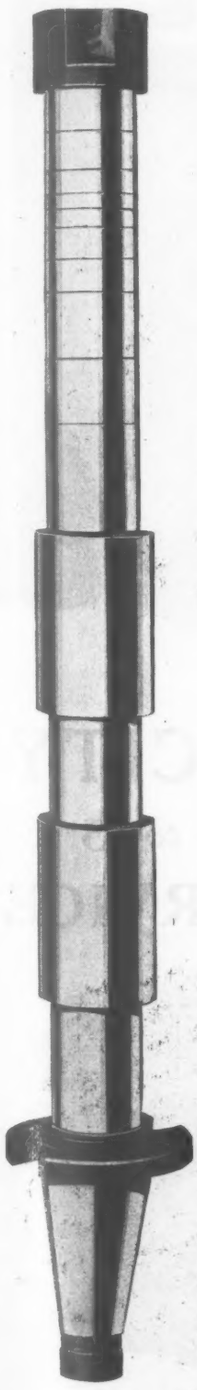
Rockford.. *Milling Machines and Special Machine Tools*.. Illinois

Ingersoll

Vol. 103 Number 12

Published monthly by Simmons-Boardman Publishing Company, 34 North Crystal Street, East Stroudsburg, Pa. Entered as second class matter. March 10, 1928, at the post office at East Stroudsburg, Pa., under the act of March 3, 1879.

Good Arbors *and* Collets Reduce Expenses

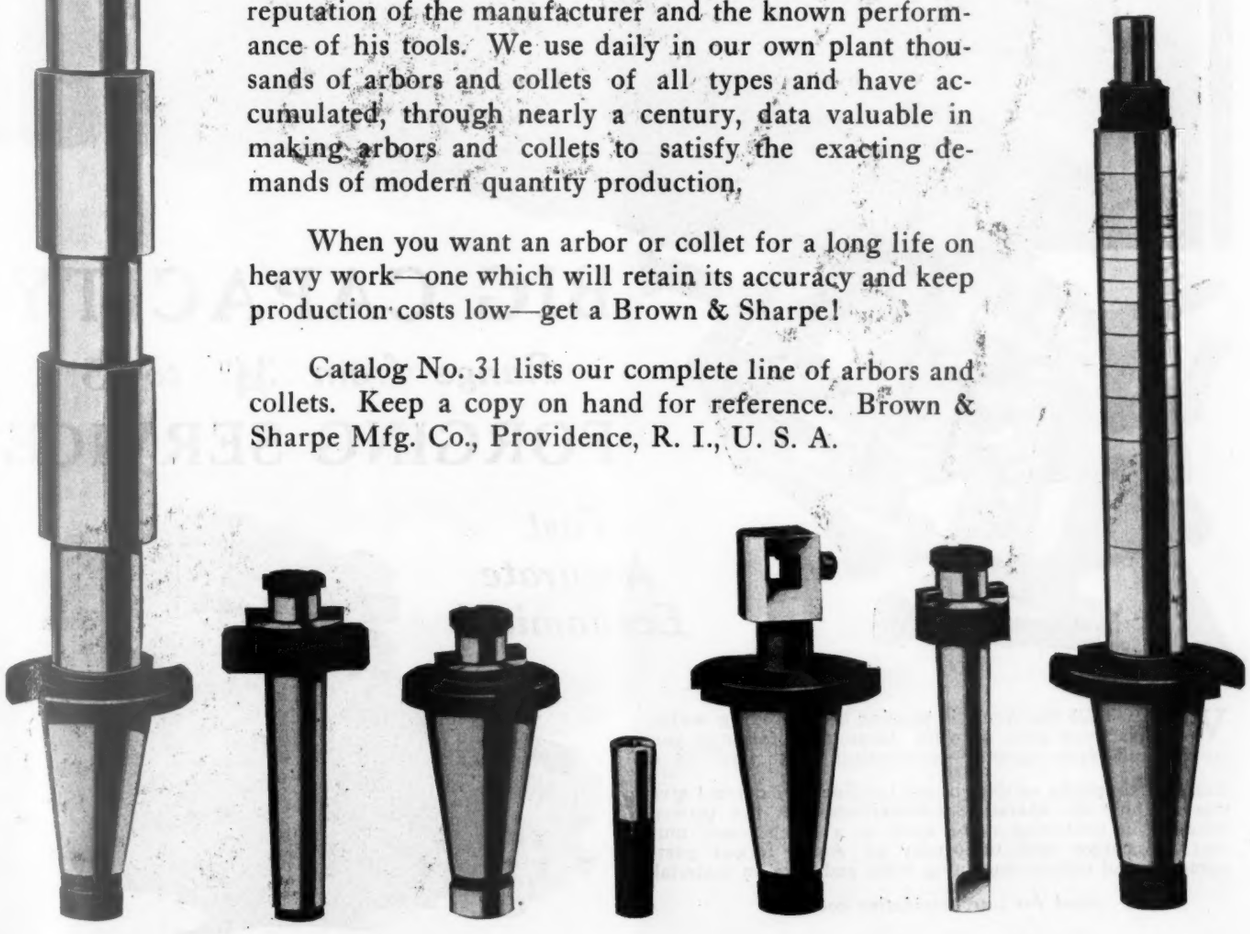


Brown & Sharpe Arbors and Collets are made to last and retain their accuracy under hard service. They are of tough, heat treated steel especially selected for the requirements and are designed for the greatest rigidity: They permit your cutters to do their best and most rapid work and so reduce production expenses.

There may be much difference in the quality of two arbors or collets without noticeable difference in their appearance. To a large extent, you must rely on the reputation of the manufacturer and the known performance of his tools. We use daily in our own plant thousands of arbors and collets of all types and have accumulated, through nearly a century, data valuable in making arbors and collets to satisfy the exacting demands of modern quantity production.

When you want an arbor or collet for a long life on heavy work—one which will retain its accuracy and keep production costs low—get a Brown & Sharpe!

Catalog No. 31 lists our complete line of arbors and collets. Keep a copy on hand for reference. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.



BROWN & SHARPE

B·S **ARBORS *and* COLLETS** B·S

ACME

BIG CAPACITY

Range from 3/4" to 5"

FORGING SERVICE

Fast
Accurate
Economical

WHETHER the Acme is heading bolts, forging wedge bolts, wrist pins or other locomotive forgings you are assured—fast—accurate—economical production.

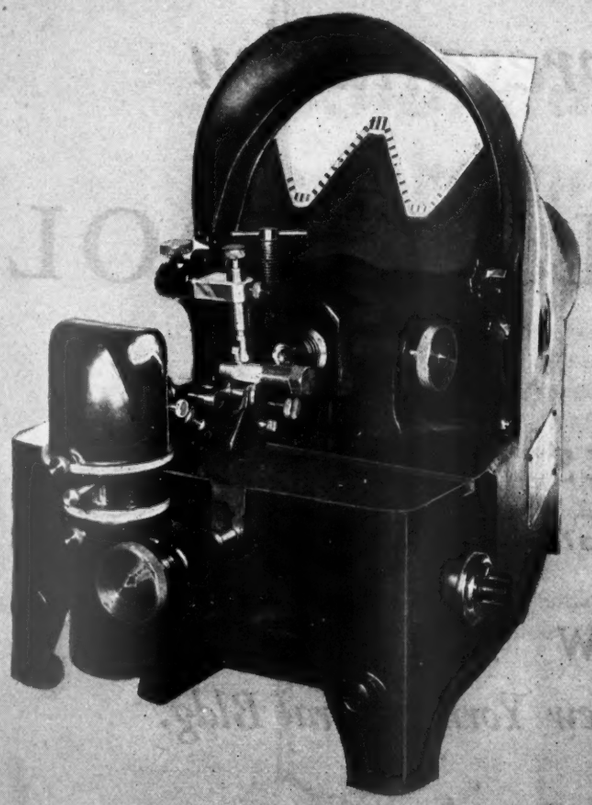
Extreme simplicity of design and handiness of control give this machine an operating convenience that has proved valuable in delivering more work at a much lower unit cost. Accuracy and uniformity of Acme forged parts speed up and reduce machining costs and save on material.

Send for our descriptive catalog.

The Acme Machinery Company

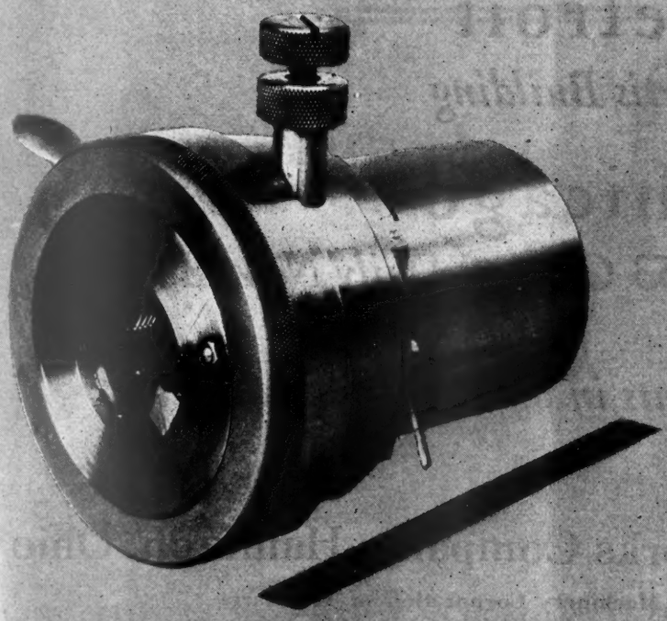
Cleveland, Ohio

Better Threads at Lower Cost--



J&L
JONES & LAMSON

Better, because they must be to pass Comparator inspection



At lower cost, because with the J&L Die, with its ground and lapped chasers, the proportion of acceptable threads is greater than any other die can produce.

JONES & LAMSON MACHINE COMPANY
Springfield, Vt.

Announcing

Direct Representation

for NILES TOOLS

in Pittsburgh
1723 Grant Building

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and Selling Agents in all the Principal Cities

The Niles Tool Works Company, Hamilton, Ohio
Division General Machinery Corporation of Delaware

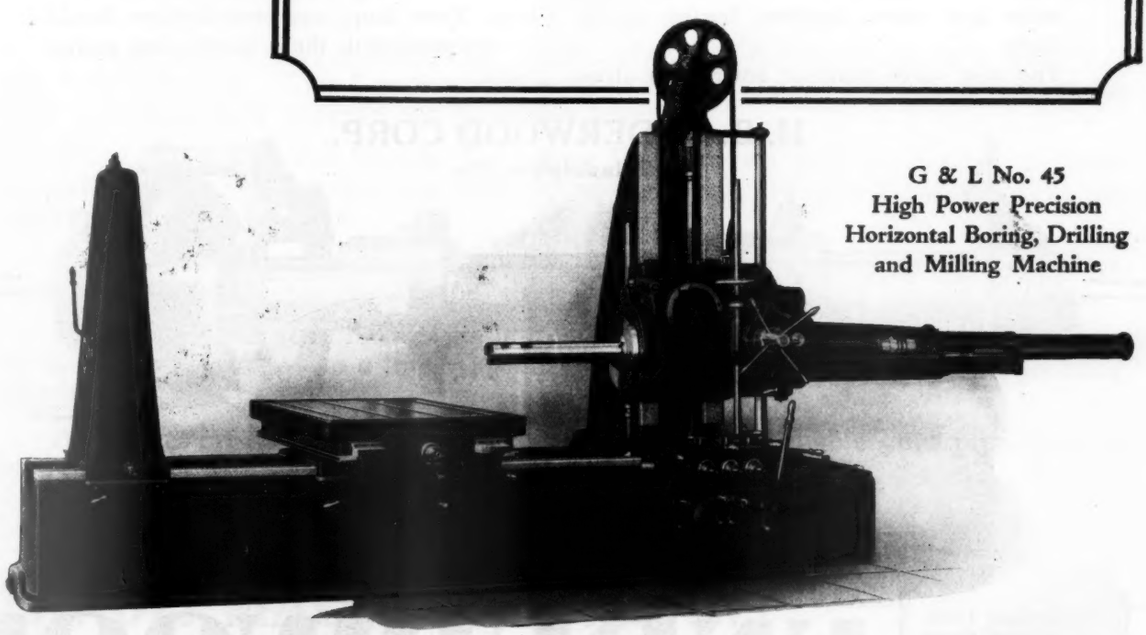
NILES

The G&L Method

Standard Machines for Special Jobs

THERE'S another real saving in the G & L Method. Take any job that requires face milling, boring, or drilling on one or more faces of the work. With individual machines, special fixtures, and oftentimes special machines must be used for each operation whereas with the G & L Method one machine does the whole job. Furthermore, many special pieces can be worked up fast and accurately in the same machine.

Think of the money in machine investment alone, not to mention the floor space and time in operation this means.



G & L No. 45
High Power Precision
Horizontal Boring, Drilling
and Milling Machine

SPECIALISTS IN HORIZONTAL BORING, DRILLING AND MILLING

GIDDINGS & LEWIS MACHINE TOOL CO. Fond Du Lac, Wis.

FOUNDED 1859

A Portable Boring Bar for Each Job

Reduces Locomotive's "Out of Service" Hours

A PORTABLE boring bar for boring cylinders and a separate boring bar for boring valve chamber bushings speeds locomotive repairs and reduces costs. You eliminate delays in schedules due to cylinder and valve chamber boring operations.

The new valve chamber boring bar illustrated below is capable of boring 16 valve chamber bushings per day. It bores both bushings at one time—is automatically centered and can be stopped at any time without leaving tool marks on the bushings. Your shops and roundhouses should be equipped with these handy time saving tools.

H. B. UNDERWOOD CORP.
Philadelphia, Pa.

The Underwood Double Head Valve Chamber Boring Bar.

Write for catalog.

Underwood Tools for railroad shops

Valve Chamber Boring Bars
Cylinder Boring Bars
Crank Pin Turning Machines
Air Pump Boring Bars
Slide Valve Seat Turning Machines
Pedestal Milling Machines

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UNDERWOOD

PORTABLE TOOLS

For Locomotive Repair Shops

NO LEAKERS—*if you use LANDIS!*

Air and steam lines threaded on Landis Pipe and Nipple Threading Machines will hold pressure. The Landis-cut thread is always clearly cut. It is correct for form and accurately tapered for its entire length.

The Landis Pipe and Nipple Threading Machine is a high production tool—as is attested to by the fact that the majority of successful Nipple Manufacturers use Landis exclusively.

A Landis is quickly and easily set up because many chasers changes are eliminated by the wide range of pipe sizes covered by one set of Landis Chasers.

Its operating cost is low. This is due to the reduction in die costs effected by the Landis Chaser and to a lower production cost secured by higher operating speeds.

A Landis Pipe and Nipple Threading Machine will enable your pipe shop to produce better work—more cheaply.

Write us today for details.

LANDIS MACHINE COMPANY

Waynesboro, Penna.

Detroit Office: 5928 Second Blvd.

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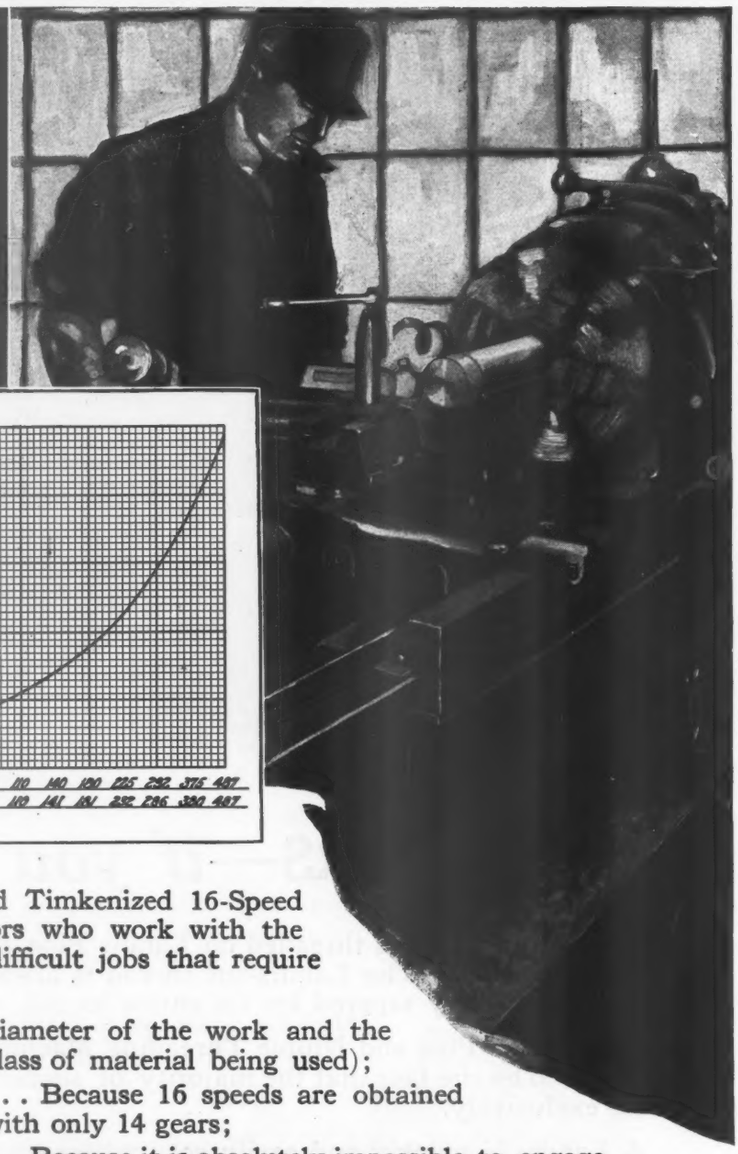
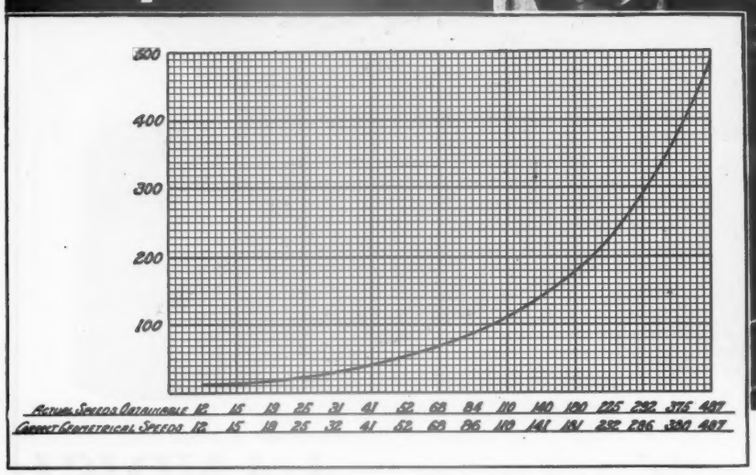
Why Many Machinists Prefer the Monarch 16-Speed Lathe





THE new Monarch Helical-geared Timkenized 16-Speed Lathe is a favorite with operators who work with the new cutting tools and who handle difficult jobs that require a wide range of speeds . . .

. . . Because the extreme flexibility of the 16-speed lathe makes it possible to do a better job—in less time;

. . . Because there is twice the chance of securing the most economical operating speed than on an 8-speed lathe (considering the diameter of the work and the class of material being used);

. . . Because 16 speeds are obtained with only 14 gears;

. . . Because it is absolutely impossible to engage two conflicting gear ratios;

. . . Because the 16 actual rates of speed are, in many instances, the ideal speeds. (See the above chart).

Production executives who want lathes with speeds adaptable to every job—write for bulletin on the new Monarch 16-Speed Helical-geared Timkenized Lathe.

THE MONARCH MACHINE TOOL CO., Sidney, Ohio *New York Office:* 857 Graybar Bldg.

Monarch lathes

Helical Gears - Timken Bearings

SMOOTHER . . QUIETER . . MORE POWERFUL

Phantom View Showing Jack Pulling Cylinder Bushing into Place

Why strip cylinders of Lagging and Sheathing to Rebush?

Why run chances of cracking cylinders by heating to rebush?

When this can be eliminated by use of

The "Wasco" Hydraulic Pulling Jack

A self-contained unit that will work on any type of power.

Send us your problems and we will show you how to save time—labor and money

We build other standard tools for use in Railroad Shops

- Riley Axle Straighteners
- Bushing Presses
- Bending Presses
- Crank Pin Presses
- Box Forcing Presses
- Walter Stock Adjusting Machines
- Spring Assembling Presses
- Spring Banding Presses
- Spring Testing Presses
- Wheel Forcing Presses, etc.
- Pit Jacks and the new Four Screw Electric Drop Pit Table

Write for Catalogs

THE WATSON-STILLMAN CO.

116 Washington Street, New York City

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St. Louis, 705 Olive St.
Philadelphia, Widener Building
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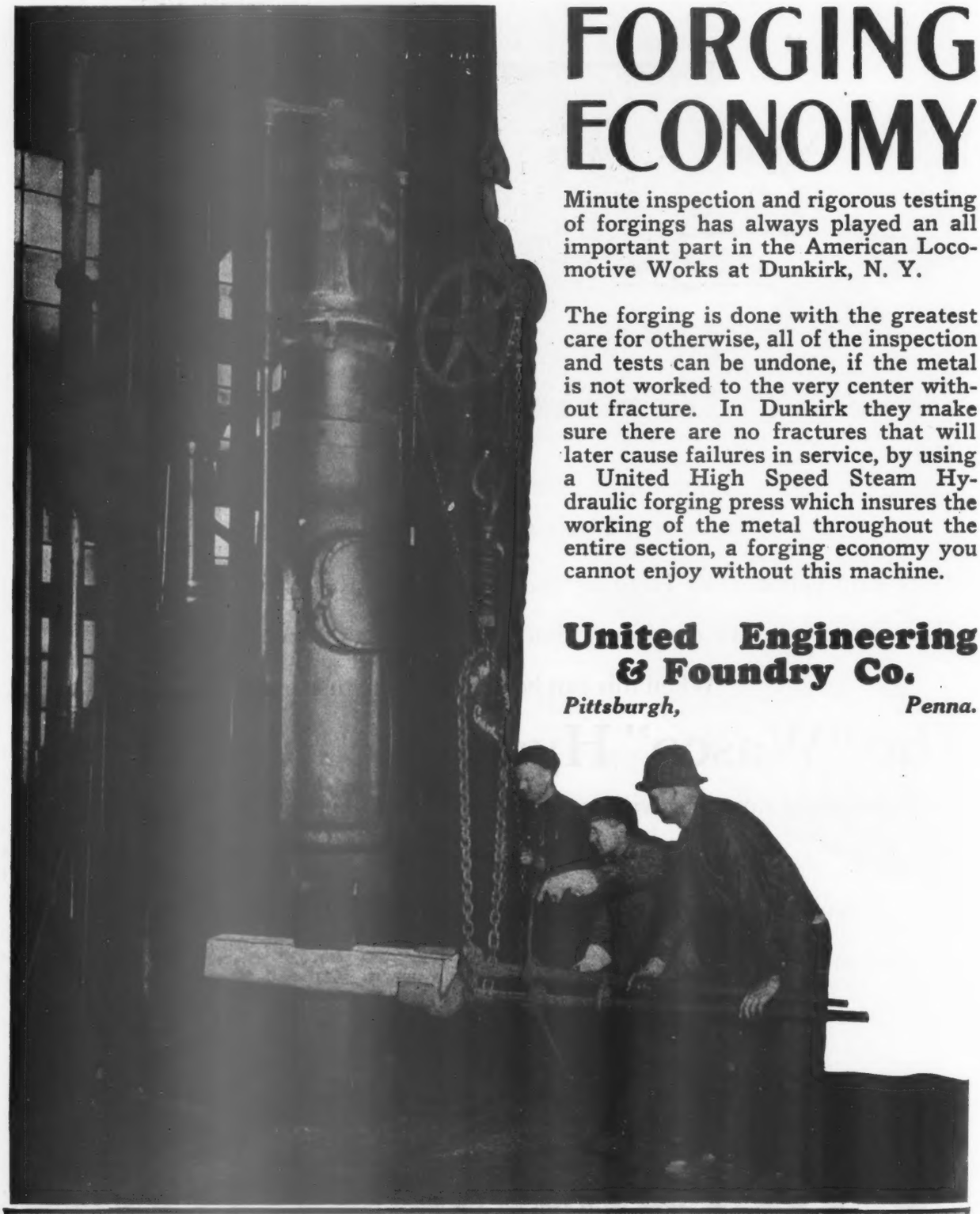


FORGING ECONOMY

Minute inspection and rigorous testing of forgings has always played an all important part in the American Locomotive Works at Dunkirk, N. Y.

The forging is done with the greatest care for otherwise, all of the inspection and tests can be undone, if the metal is not worked to the very center without fracture. In Dunkirk they make sure there are no fractures that will later cause failures in service, by using a United High Speed Steam Hydraulic forging press which insures the working of the metal throughout the entire section, a forging economy you cannot enjoy without this machine.

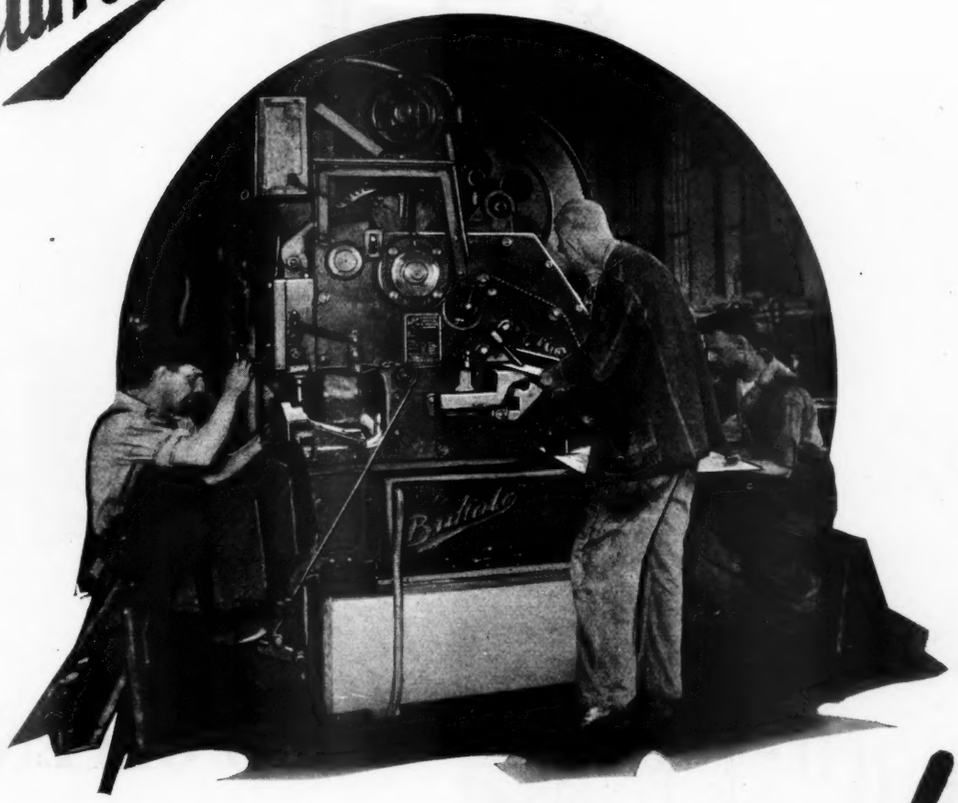
United Engineering & Foundry Co.

Pittsburgh, Penna.

UNITED FORGING PRESSES

HIGH SPEED STEAM HYDRAULIC

"Buffalo" Iron Workers



Up Goes Production!

—that's the story every time a Buffalo Universal Iron Worker replaces other equipment. And it's the story here in the plant of The Eastern Bridge & Construction Company of Worcester, Mass.

Their No. ½ Universal Iron Worker has been in service since 1925 and has given perfect satisfaction in every way. As the illustration suggests, it is worked at full capacity almost every second of the shop's 55-hour week, and has demonstrated an ability to handle any extreme of production with consistent speed, efficiency and economy.

At the time of the photograph the machine was punching 2″ x 2″ x ¼″ angle iron, shearing 4″ x 4″ x ⅜″ angle iron and cutting 12″ x 24″ x ⅜″ boiler plate. By itself, the No. ½ Universal Iron Worker is a machine of unusual versatility. Equipped with special tools, it can be applied to any metal work in a shop of this kind.

Write us about your metal work. There is a Buffalo machine that can make it more productive—more profitable.

Buffalo Forge Company

184 Mortimer Street, BUFFALO, N. Y.

IN CANADA: Canadian Blower & Forge Co., Ltd., Kitchener, Ontario.

..but NO OFFENSE was meant

A SMALL shop listed on our records as operating a Putnam Double Housing Planer was visited by one of our Sales Engineers. A patriarch received him pleasantly until the representative solicited the sale for a new planer. Then the old chap's manner changed. "Why buy a new planer when the old one is still working perfectly? It's only between 50 and 75 years old."

Since that planer was delivered, Putnam Planers have been re-designed again and again incorporating each and every new proven development. Today Putnam Planers are the happy combination of the quality of seventy-five years ago with the latest planer developments.

Putnam Planers are long lived, but more important, they do their work accurately, quickly and with minimum maintenance expense. Have one of our Engineers call and point out their many new features.

PLANERS
Open Side,
Double Housing

BORING MACHINES
MILLING MACHINES
DRILLING MACHINES

HEAVY DUTY
MACHINE TOOLS
For Industrial and Railroad Shop Service

SPECIAL PURPOSE MACHINES

Manufactured at
PUTNAM MACHINE WORKS, Fitchburg, Mass.
Owned by
MANNING, MAXWELL & MOORE, Inc.
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MANNING, MAXWELL & MOORE, Inc.

AJAX

Where Power Counts–Choose AJAX

WHERE power is a determining factor, Ajax Heavy Duty Upsetting Forging Machines are the logical choice.

Power because of the twin flywheels and twin gears, which drive the crankshaft in constant rotation.

Power because of the drop lock stop motion mechanism which connects these powerful moving parts with the slides converting a maximum of stored-up energy into useful work.

Both are exclusive Ajax Features and both are paramount considerations in a judicious choice.

THE AJAX MANUFACTURING COMPANY

621 Marquette Building
Chicago

CLEVELAND

1369 Hudson Terminal Bldg.
New York, N. Y.

50% Savings

on

Cylinder Bushings and other V. T. L. Jobs

WITH a *High Bed 54" Vertical Turret Lathe* you can bore your cylinder bushings and turn them at the same time—a saving of at least 50% over former methods.

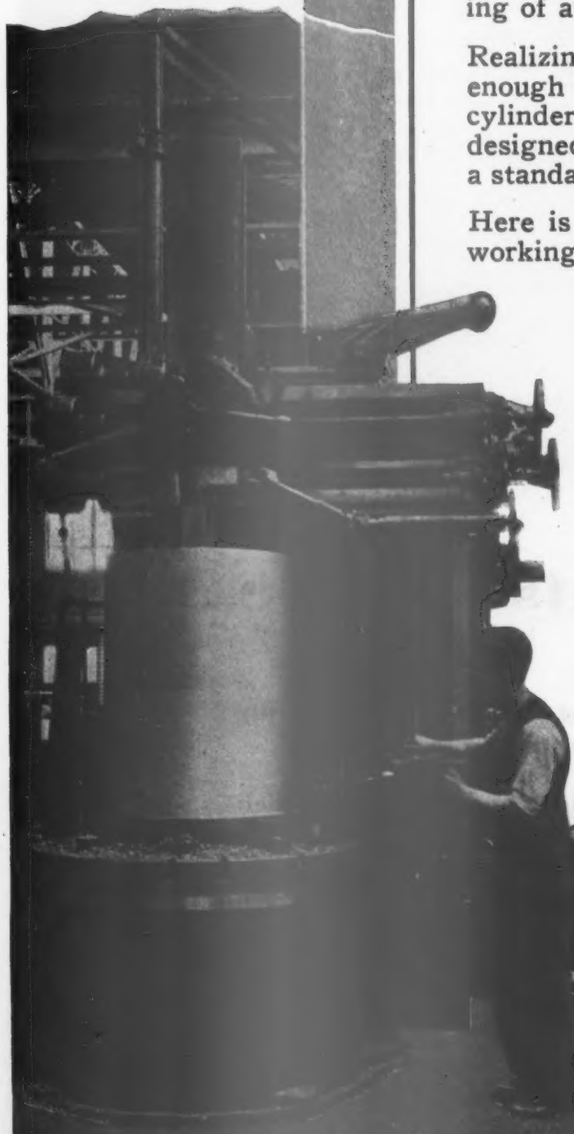
Realizing that there are very few shops with enough work to keep one machine busy on cylinder bushings BULLARD engineers have designed this unit for rapid conversion into a standard V. T. L.

Here is a unit that can be kept busy every working day throughout the year—its rugged design makes it especially adaptable for those heavy jobs; *cylinder heads, piston heads, bull rings, crossheads, small wheel centers,* etc.

The production capacity of this BULLARD insures big profits from the investment — remember the 54" *High Bed Vertical Turret Lathe* on this year's requisition.

The Bullard Company

Bridgeport Connecticut



BULLARD

High Bed 54" VERTICAL TURRET LATHES

SELLERS

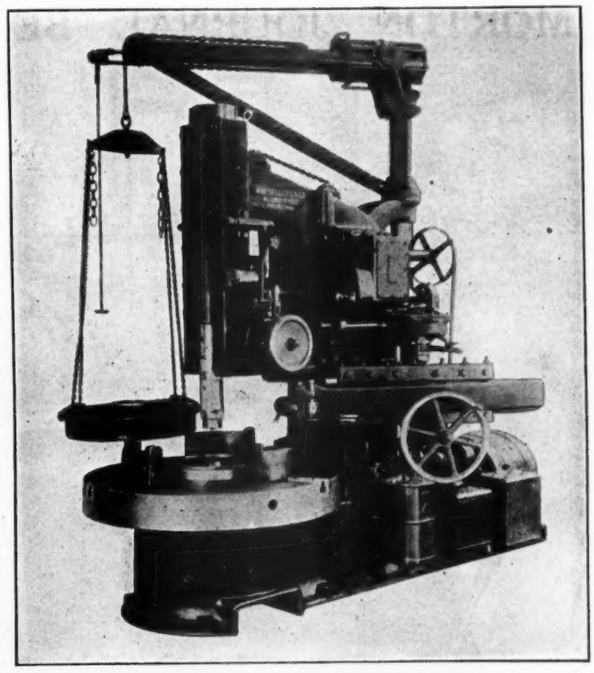
RAILWAY SHOP TOOLS

The SELLERS CAR WHEEL BORER
The SELLERS CAR WHEEL LATHE
The SELLERS DRIVING WHEEL LATHE
The SELLERS DRIVING BOX BORER

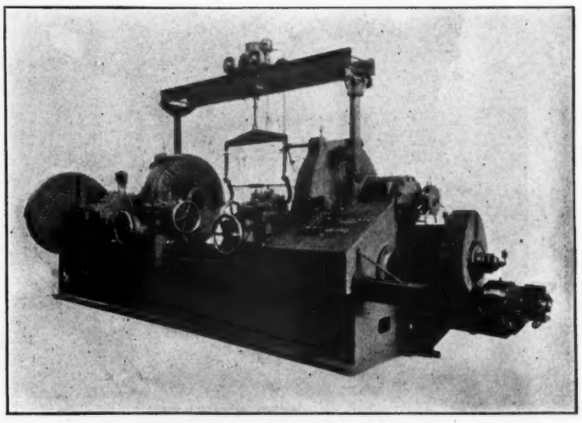
Also

Planers; Planer Type Milling Machines; Boring and Turning Mills; Floor Boring Machines, both floor plate and planer type; Drill Grinders; Tool Grinders; Locomotive Injectors, etc., etc.

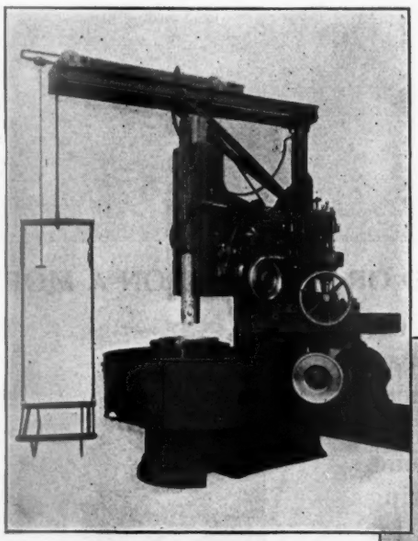
WM. SELLERS & CO., *Incorporated*
1600 Hamilton Street Philadelphia



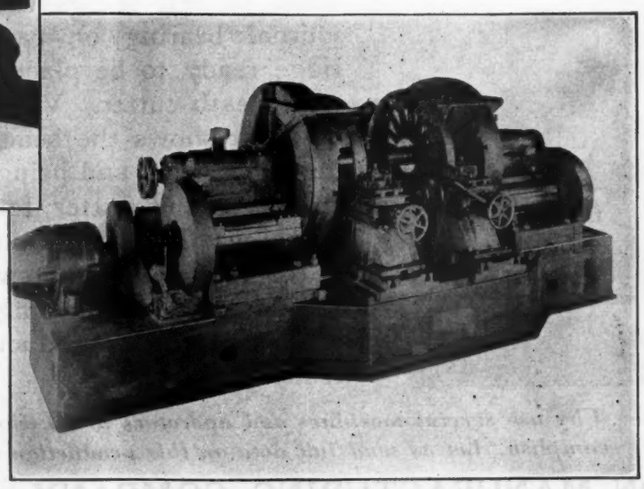
The SELLERS Car Wheel Borer



The SELLERS Car Wheel Lathe



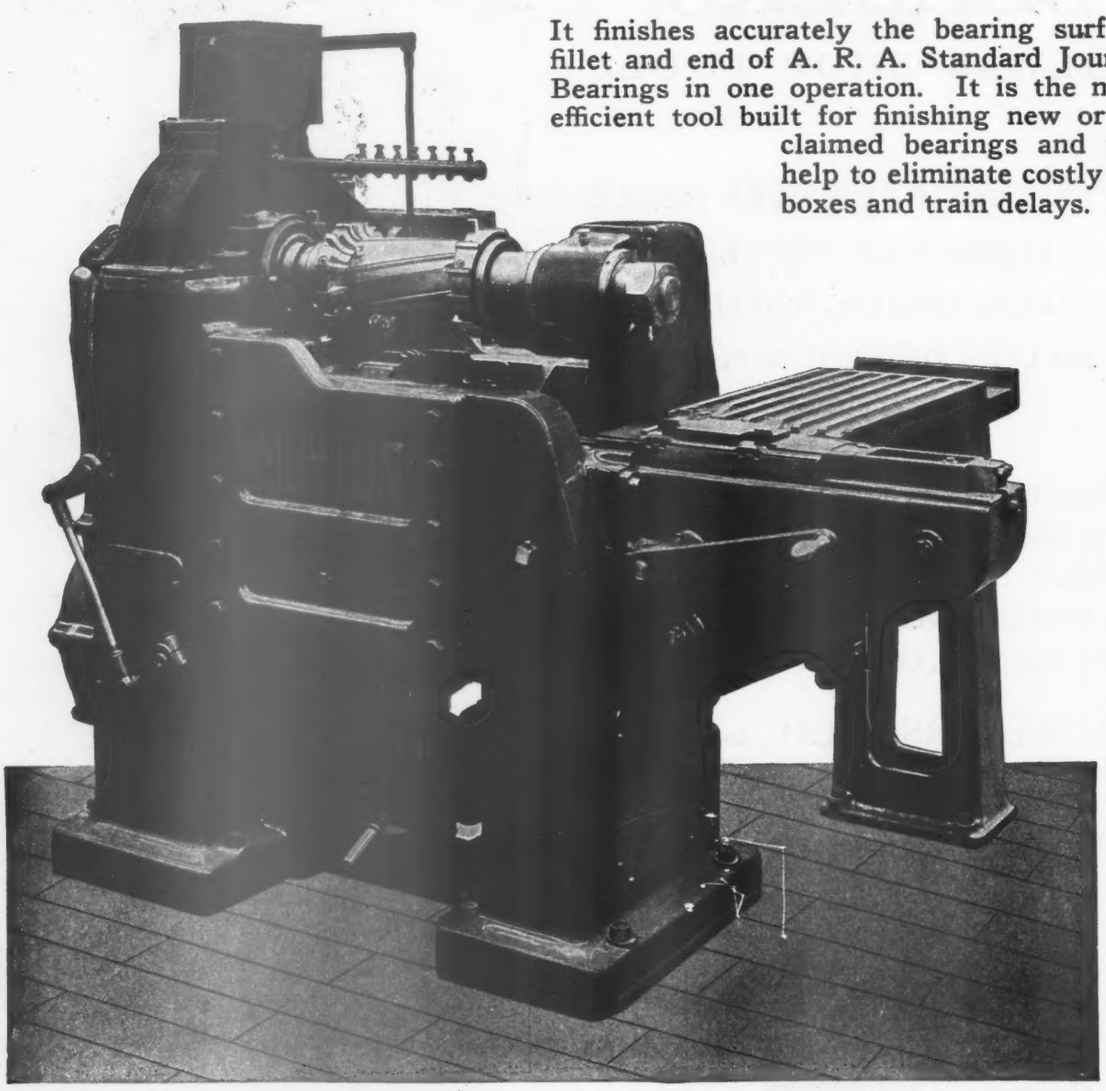
The SELLERS Driving Box Borer



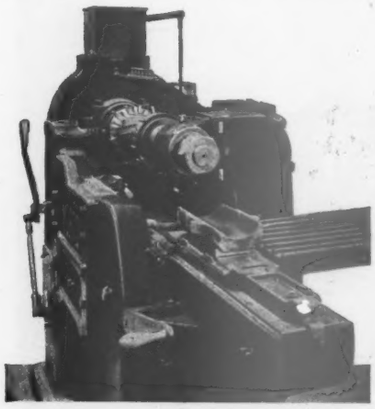
The SELLERS Driving Wheel Lathe

MORTON JOURNAL BEARING FINISHING MILLER

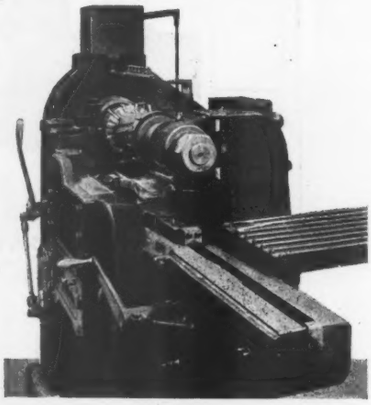
It finishes accurately the bearing surface, fillet and end of A. R. A. Standard Journal Bearings in one operation. It is the most efficient tool built for finishing new or reclaimed bearings and will help to eliminate costly hot boxes and train delays.



SPECIFY YOUR BEARINGS TO BE BROACHED OR FINISHED ON A MORTON



View on left shows the journal bearing on carriage ready to be placed underneath cutter. View on right shows the bearing in position and being raised to the cutter for finishing. This operation is completed in a few seconds and the bearing is a finished product ready for service.



Why use several machines and operators to do what one Morton will accomplish. Let us send full data on this production tool. Reference 11 R.

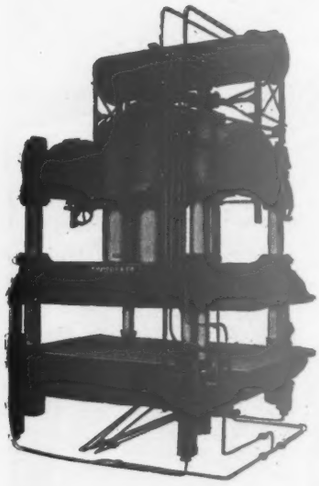
MORTON MANUFACTURING COMPANY, Muskegon Heights, Mich.

BECAUSE they thread narrow aisles, take grades easily, turn sharp corners, stand up under overload, ride rough floors without jarring the load, and are safe for even a novice to operate, Baker trucks, tractors and cranes have been accepted by hundreds of companies as the best and surest ways to speed up production and save money in material handling.
ELECTRIC TRACTORS AND TRUCKS
Baker

Baker Industrial Truck Division of THE BAKER-RAULANG COMPANY, *Cleveland*

HYDRAULIC TOOLS AND MACHINERY

FOR RAILROAD, LOCOMOTIVE AND CAR SHOPS



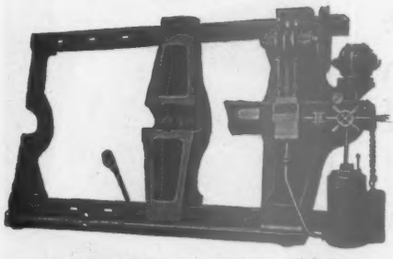
1500-TON FOUR COLUMN FLANGING PRESS

We build a complete line of up-to-date hydraulic tools designed for efficiency and economy in operation.

Our standard hydraulic tools are manufactured in all sizes and types, and comprise:

Four Column Flanging Presses
Sectional Flanging Presses
Riveters
Bushing Presses
Wheel Presses
Crank Pin Presses
Bending Presses
Forging Presses
Punches
Shears
Spring Machinery
Accumulators
Pumps

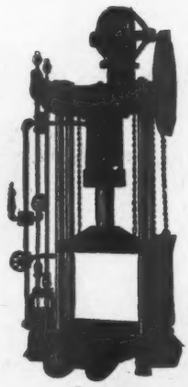
HYDRAULIC RIVETER



HYDRAULIC DRIVING WHEEL PRESS

Our experience, extending over a long period of years, together with our excellent shop facilities also enable us to design and build hydraulic machinery to meet any special requirements.

Our illustrated catalogues "Hydraulic Machinery" and "Hydraulic Valves & Fittings" mailed upon request.



HYDRAULIC BUSHING PRESS

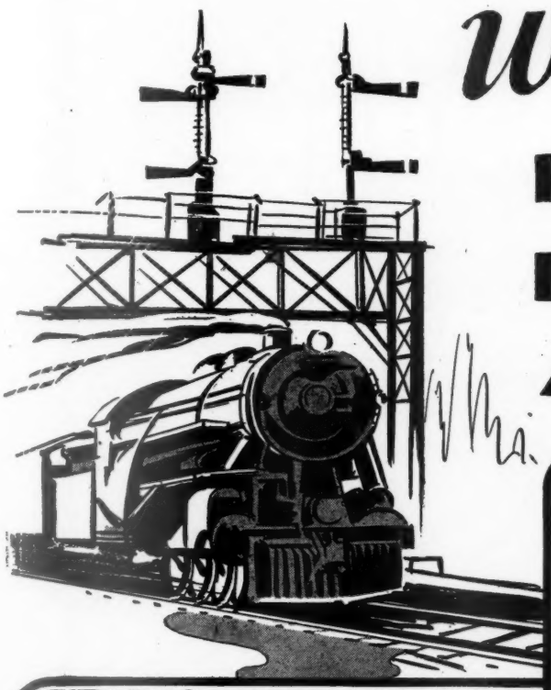
HYDRAULIC MACHINERY & OPERATING VALVES

R. D. WOOD & CO.

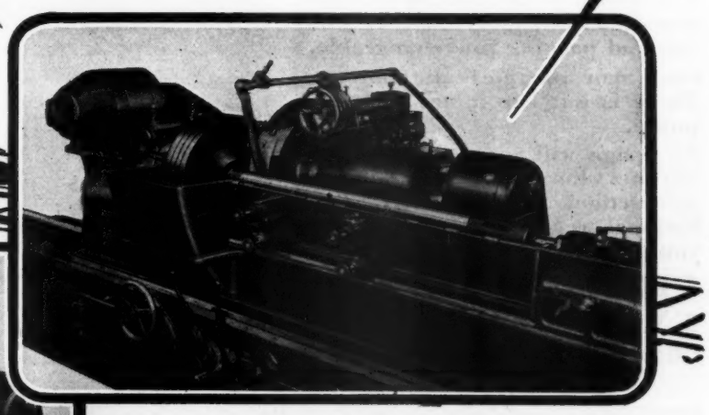
ESTABLISHED 1803

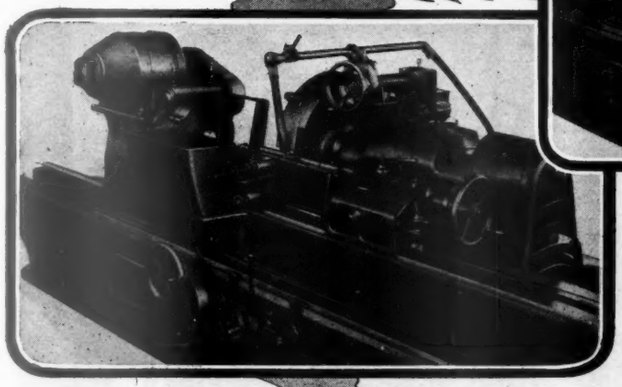
PHILADELPHIA, PA.

CAST IRON PIPE, HYDRANTS AND VALVES



wherever—
Railroad Progress Demands Extreme *Dependability!*





Stop friction wear by grinding and you will be surprised at the increased dependability and efficiency of your rolling stock.

Grinding produces a mirror-like finish; thereby reducing the possibility of hot boxes. Grinding prolongs the life of piston rods, axle journals, valve yoke stems, crank pins and like parts. Grinding saves material. Grinding takes minutes where rolling takes hours. Grinding means less time in the shop—more time in active duty.

Progress, then, demands the use of the grinding machine in the railroad shop. And the Landis Hydraulic Gap Grinder is the very machine to fill the need.

Ask for Catalog I-28 as the first step in learning more about this modern, cost-reducing grinder.

LANDIS
TOOL COMPANY
WAYNESBORO ~ PA.

DETROIT CHICAGO NEWARK PHILADELPHIA

60 SECONDS FLOOR TO FLOOR

A PAIR of wheels a minute—is average demounting performance with a Chambersburg High Speed Duplex Car Wheel Press. Mounting time is 90 seconds, floor to floor. With full hydraulograph readings, two and three-quarter minutes a pair.

Speed is the outstanding quality of the Chambersburg Duplex Wheel Press, but it is also remarkable for its solid, substantial construction and its small number of moving parts.

Repairs are few. Depreciation nil. The whole mechanism is directly accessible. Cylinders are of one size and packing interchangeable.

One man operates all controls. There is but one motor and one pump.

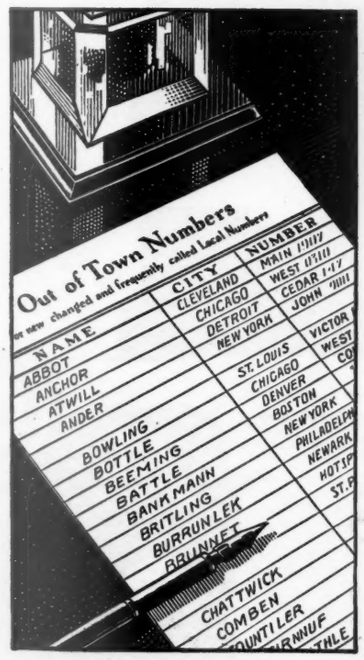
Its design will repay the study of anyone who is working to boost production. The Chambersburg-National representative can give you all details.

CHAMBERSBURG ENGINEERING CO.
Chambersburg Penna.

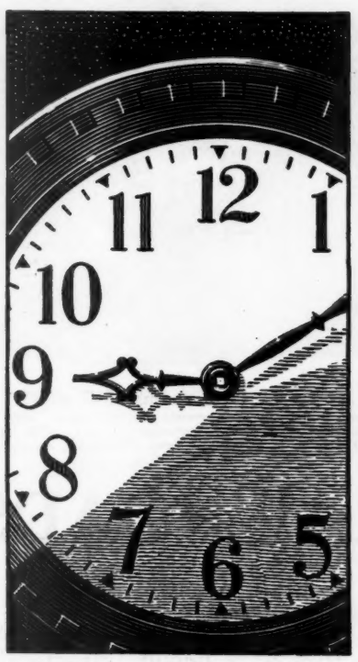
CHAMBERSBURG

Sold by
CHAMBERSBURG-NATIONAL
COMPLETE FORGING EQUIPMENT
CHAMBERSBURG, PA. TIFFIN, OHIO
NEW YORK, 152 W. 42nd Street CHICAGO, 565 W. Washington Street
DETROIT, 2457 Woodward Avenue

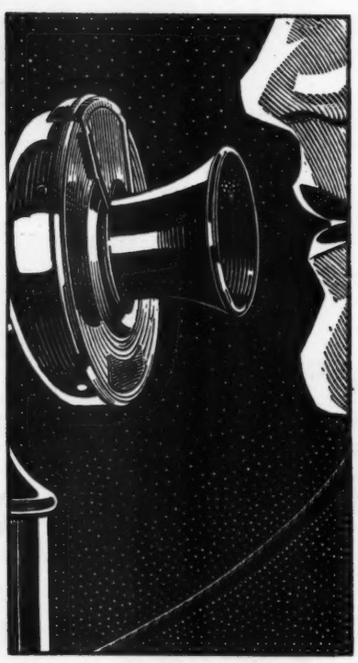
3 simple Suggestions for Telephoning between Cities



Call by number, whenever you can



Call during the less crowded hours of the business day



Speak distinctly and directly into the mouthpiece

HERE are three simple suggestions that are almost sure to help you in getting the most out of your telephone calls between near and distant towns.

Call by number, whenever you can; it will save your time. It is useful to know the number, especially for calls that you may make frequently. "Information" will gladly give you the number of any person or concern you wish, so that you can make a note of it for the future. It is a convenience to your customers to print your own telephone number on your letterhead.

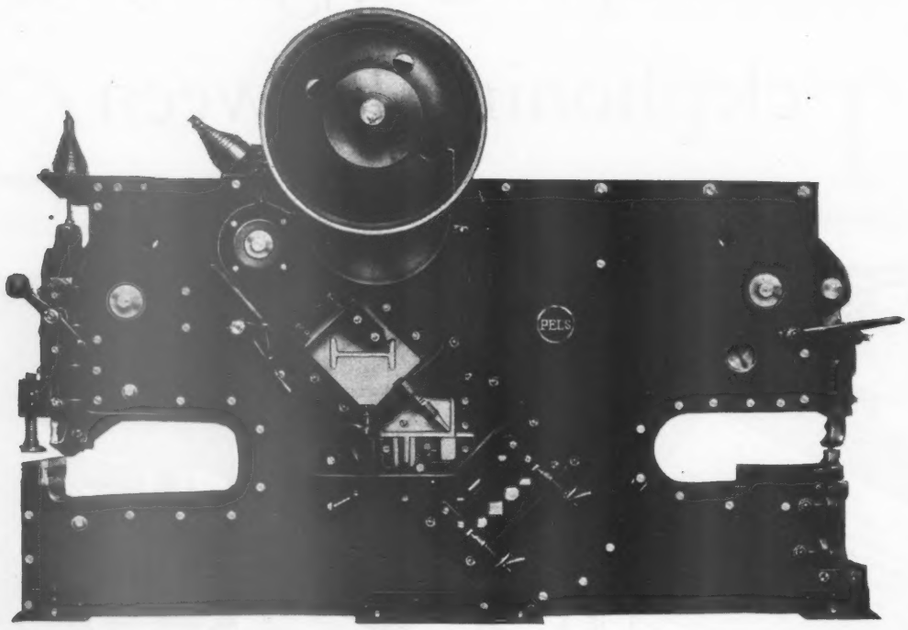
Make your calls when the men you want to reach are likely to be less busy. Try calling before 9.30 in the morning, between noon and 2, or shortly after 4.

Third, speak distinctly into the telephone, keeping your lips close to the mouthpiece. A natural speaking voice such as you use in talking to a man across your desk makes distant calls as clear as local calls.

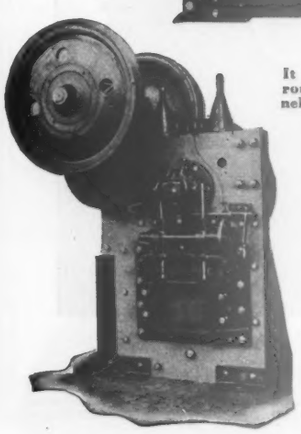
Remembering these three points will make your telephone service easier and better than ever.

Inter-city calls are ideal for making appointments. Following up visits. Clearing away misunderstandings. Completing buying and selling transactions. Bell Telephone Service is *Convenient . . . Economical . . . Universal.*

PELS SHEARS & PUNCHES



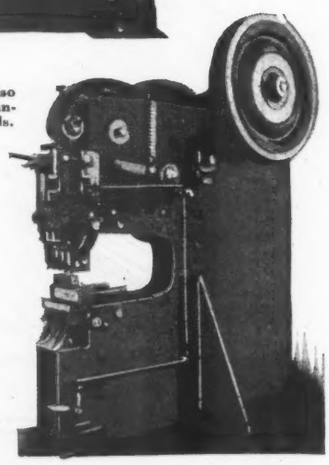
A favorite type among Railroads:
It punches—shears plate and flats—cuts angles square and on bevel, also rounds, squares and tees—all without change of tools. Also cuts beams, channels, tees, etc. with separate knives without disturbing set-up of other tools.



Bar and Billet Shear

RAILROADS

use Pels Shears and Punches in ever increasing numbers. On many lines they have become practically standard equipment. The frames of all Pels machines are of guaranteed unbreakable steel plate construction originated by us 30 years ago. A wide variety of combination and single unit types fills every requirement.



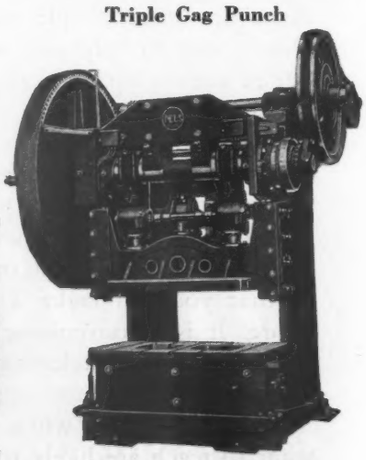
Triple Gag Punch

Also:
Gate Shears, Scrap Shears, Beam Shears, Copers and Benders

Splitting Shear and Punch, Angle, Bar and Tee Cutter—a very popular machine.

Henry Pels & Co. INCORPORATED
90 West St New York

Largest manufacturers of punching and shearing machines in the world.



Heavy Duty Press

SHEARS—PUNCHES—HEAVY PRESSES

Railroad Tools

you'll find in busy Railroad Shops

Make CONSOLIDATED your Machine Tool Headquarters—we are specialists in the building of Railroad Tools.

Journal Truing and Axle Lathes—Crank Slotters
Car Wheel Borers—Lathes—Tire Mills
Vertical Boring Mills—Planers
Crank Planers—Rod Boring Machines
Rail Drills—Rod Milling Machines
Link Grinders—Drill Presses
Cylinder and Valve Chamber Boring Machines
Punches, Shears and Plate Shop Equipment

—all special tools—designed and built expressly for railroad shop service. They are not merely machine tools *adapted* to railroad work—but *Railroad Tools* backed by nearly three-quarters of a century of experience in the design and building of machine tool equipment to meet the special needs and requirements of the progressive locomotive and car repair shop.

We will gladly send you complete information covering the entire Consolidated Line. If you have a special problem—our engineering department is at your service.

Write for literature.

Get Acquainted With the Consolidated Line

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Engine Lathes
Boring Mills—All Sizes
Planers—All Sizes
Heavy Duty Slotters
Railroad Shop Tools
Car Wheel Borers, etc.

COLBURN
Drill Presses
Heavy Duty Drills
Gang Drills
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Multiple Spindle Drills
(Vertical and Horizontal Types)
Multiple Spindle Rail Drills
Staybolt Threading Machines
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NEWTON
Horizontal Milling Machines
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Punches and Shears
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Magic Quick-Change Drill Chucks
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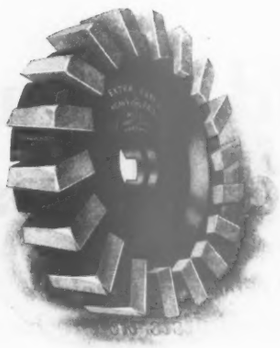
BETTS - COLBURN - NEWTON - HILLES & JONES - MODERN

CONSOLIDATED

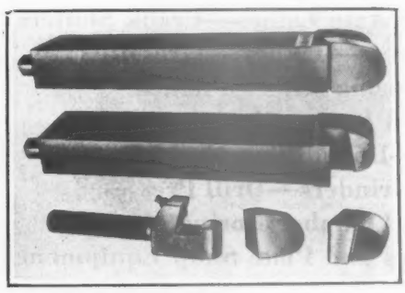
CONSOLIDATED MACHINE TOOL CORPORATION *of* AMERICA, Rochester, N. Y.

CUTTER vs. MACHINE



A MILLING CUTTER THAT WILL TAX THE MACHINE

EXTRA EXTRA HEAVY DUTY FACE MILL "OK" PATENTED TYPE IS SHOWN IN THE CUT



Lathe Wheel Set

MILLING operations can be speeded up if cutters made sturdy enough are selected. Why not have the margin of safety on the cutter side for a change? Special designs can be had with the "OK" Patented features.

"OK" Tools are more than tools—they are a System whereby shop conditions are improved in many ways by their adoption. Each machine has its set and tools for different operations are changed in a few seconds by simple lock adjustment. Tools come ground and tempered ready for immediate use. This feature alone insures constant machine operation.

"OK" Standard Shaper Set

"MORTON" SHAPER

STANDARD "OK" SET FOR "MORTON" SHAPER is considered proper tooling for all railroad shops. This same system of tooling can be had for all type machines.

Our Service Department will gladly explain or demonstrate at your request.

Sole British Representative
Richard Lloyd & Co., Ltd.
Birmingham, England.

—THE TRADE OK MARK TOOL CO., INC.—

TOOLS FOR
Lathes — Shapers—Planers
— Boring Mills — Inserted
Tooth Milling Cutters

SHELTON, CONN., U. S. A.

BENJAMIN

Pit Lighting Unit

A New Unit for the Effective and Safe Lighting of Steam and Electric Railway Service Pits

The Benjamin Pit Lighting Unit is designed for installation in the side walls of the service pit, for the effective lighting of the underbody of the car as well as the pit itself.

The heavy cast-iron body sets back in the masonry permitting full use of the working area, adding greatly to the freedom of movement and the safety of the workmen.

The Pit Lighting Unit is built especially for railway service pits. It is impervious to water, gas or other corrosive elements. A heavy cast-iron body and cover frame securely houses the lamp and reflector. A strong brass wire guard protects the Pyrex heat-resisting glass cover from accidental breakage from contact with a spanner or other heavy tool.

The lighting reflector is of porcelain enameled steel of a special trough shape design. It has a wide lateral distribution to build up illumination between units and accommodates either 100 or 150-watt lamps.

Ample wiring space is arranged for the entrance of conductors, and provision is made for the easy removal and replacement of lamps.

Many other important and interesting features are described in a special bulletin which will be sent on request. Write for it today.

Benjamin Electric Mfg. Co.

General Offices and Factory

Des Plaines, Ill

(a Suburb of Chicago)

Divisional Offices and Warehouses

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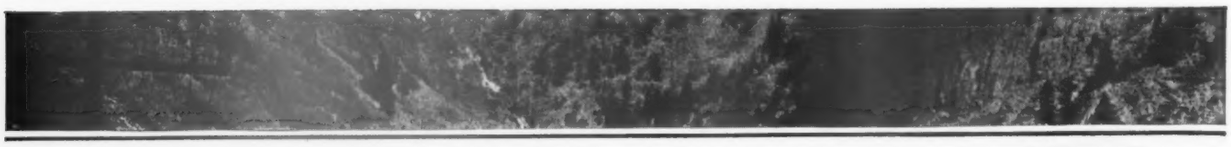
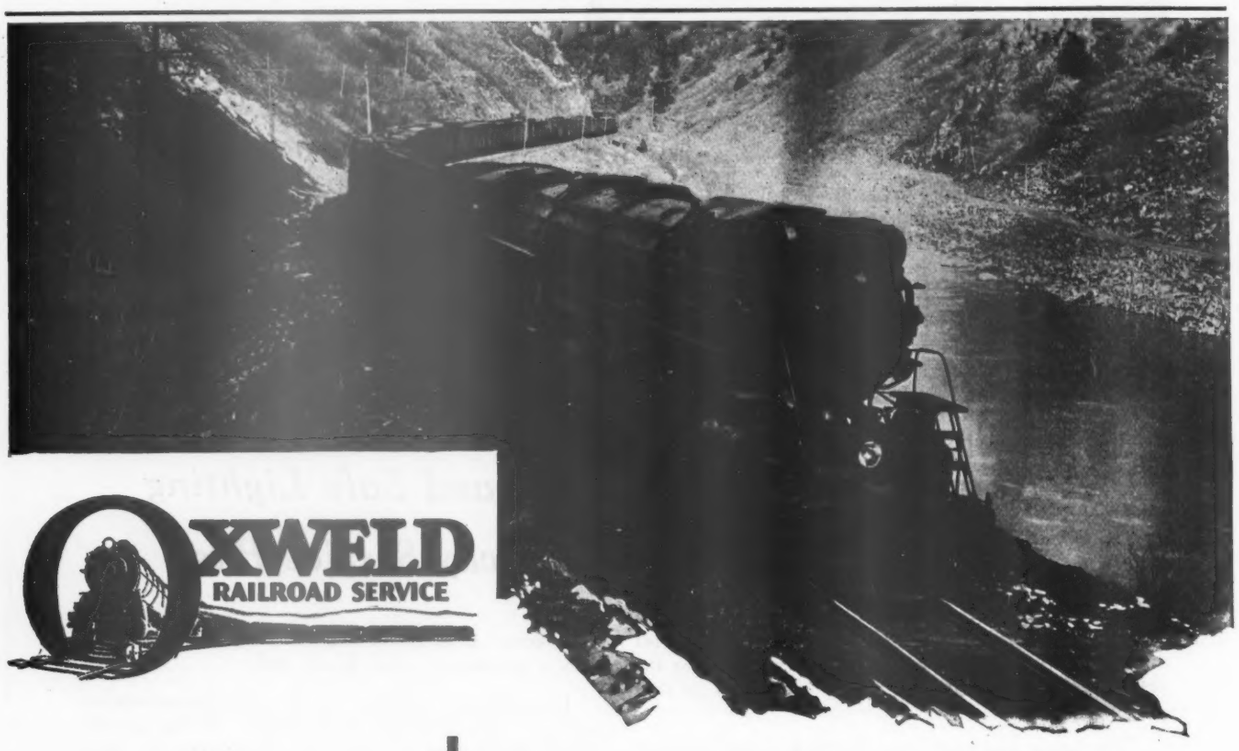
247 W. 17th St.

Chicago
111 No. Canal St.

San Francisco
448 Bryant St.



LONGER–HEAVIER–FASTER TRAINS



IMPROVED condition of track, resulting from modern methods of track maintenance, is one of the prime factors enabling the safe operation of power units of sufficient capacity to handle the longer, heavier trains necessary to take care of increasing freight business. Faster movement of heavy trains materially increases the capacity of the railway plant and is an important contribution toward the betterment of railway earnings.

The Oxweld Railroad Service Company, by supplying the oxwelding needs of a majority of the Class 1 railroads of the country is helping in the constant improvement of maintenance methods.

THE OXWELD RAILROAD SERVICE CO.
Unit of Union Carbide and Carbon Corporation
UCC

NEW YORK CITY
Carbide and Carbon Bldg.

CHICAGO
Carbide and Carbon Bldg.

W. L. BRUBAKER & BROS CO.

IT'S A BRUBAKER

Now I Know my troubles are over

THE mechanic knows that Brubaker Taps hold their edge for long periods of service that breakage is negligible and that replacements are few and far between.

He knows too, that he can make a better showing because Brubaker Spiral Fluted Staybolt Taps make cutting easier and faster, assuring more holes per hour with less effort.

So complete is the Brubaker economy that those responsible for keeping maintenance low and production high should specify Brubaker.

Write for detailed information

BRUBAKER

Originators of the Spiral Fluted Staybolt Tap Patent No. 1,434,870. Avoid imitations.

Also manufacturers of all style taps, reamers and dies.

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SALES OFFICE 50 CHURCH ST. N.Y.

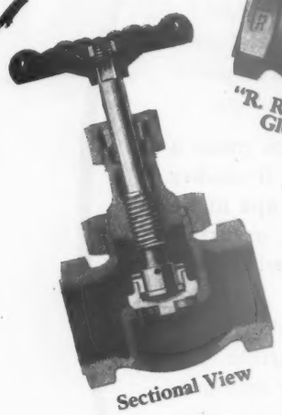
STANDARD-SPECIAL TAPS-DIES-REAMERS

FACTORY MILLERSBURG, PA.

for Locomotive and General Railroad Service

LUNKENHEIMER
"R.R.REGRINDING"
GLOBE AND ANGLE VALVES
250lb. W.S.P.

"R. R. Regrinding" Globe Valve



Sectional View

"R. R. Regrinding" Angle Valve

The satisfactory results obtained in actual service have created a steadily increasing demand for Lunkenheimer "R. R. Regrinding" Valves.

Several of the large Railroad Companies have standardized on these valves for locomotive and general shop and yard service. By thus standardizing they minimize stock requirements, facilitate repairs and simplify ordering and handling.

Seating surfaces are regrindable and all parts, including bronze disc are renewable. Seat faces can be reground and parts renewed without removing valve from pipe line. Stuffing box is repackable under pressure. Gland is provided in all sizes.

Lunkenheimer "R. R. Regrinding" Valves embody all the factors which insure continuous satisfactory service with infrequent delays for repairs and replacements. The low maintenance expense insures low valve cost.

Lunkenheimer Valves and Engineering Appliances for Railroad Service are fully described and illustrated in booklet No. 521 G. E. Write for a copy.

THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO BOSTON PHILADELPHIA
PITTSBURGH SAN FRANCISCO LONDON
EXPORT DEPT 318-322 HUDSON ST., NEW YORK

LUNKENHEIMER
VALVES

3-67R-75

One Namesake I'm Proud of— HERCULES

Air Tools

Amazingly strong was Hercules; but noted far more was he for his ability to conquer tasks that his lesser kindred could not master . . . .

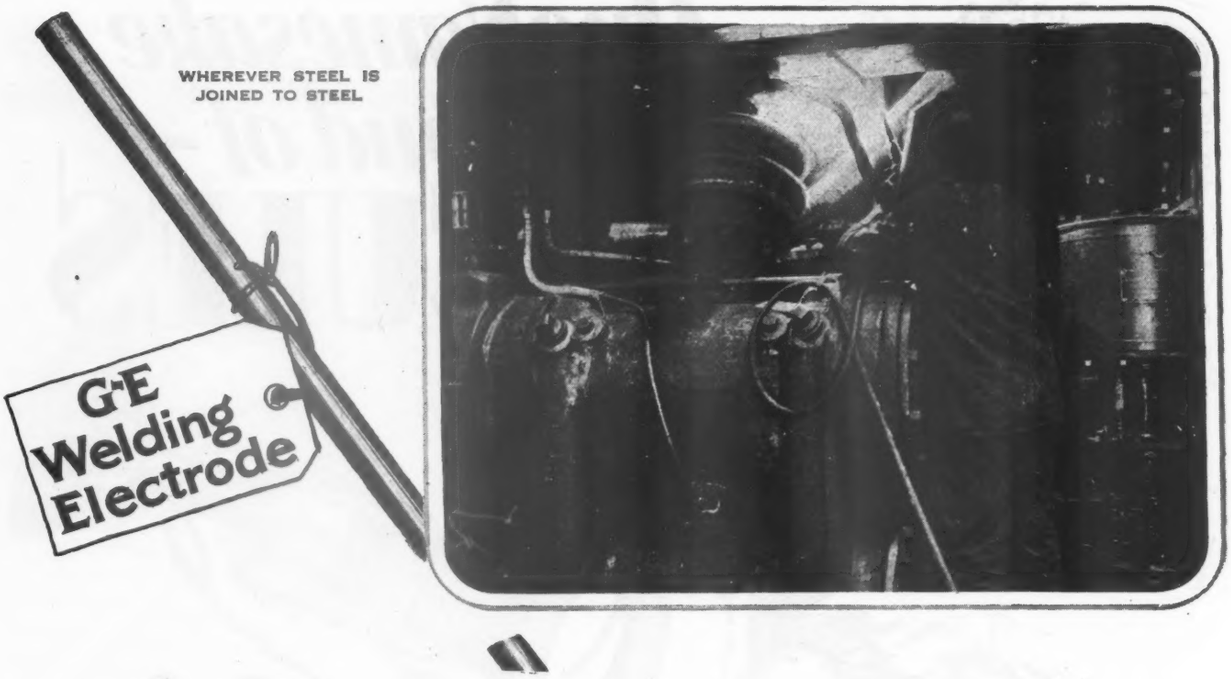
Slaying the Nemean lion . . . . taking alive a monstrous wild bull devasting Crete . . . . a mighty doer of deeds was he after whom Hercules Air Tools was named. ¶ Like their name-father, Hercules Air Tools also conquer tasks that others cannot master. Their strength is abundant, yet less air is used. They yield continuous high-speed production without heating or vibration. Invariably they win comparative tests, because of *correct* rotary action—no pistons, no toggles, no reciprocating parts. ¶ This true pioneer of *really successful* air tools merits a chance to prove its powers. Put Hercules on the job—and get it done!

A Hercules for test if you wish it—or send for catalog, stating your requirements.

The Buckeye Portable Tool Co.
DAYTON, OHIO U.S.A.

HERCULES

GRINDERS SANDERS
DRILLS BUFFERS
NUTSETTERS SCREWDRIVERS



—satisfactory at every angle

One characteristic of G-E Type "F" electrode invariably pleases welding operators. Type "F" can be applied at any angle—flat, horizontal, vertical, or overhead—with satisfactory results. Locomotive parts, sometimes difficult to reach, are easily welded by Type "F" because its arc stability is little affected by the position in which it is held.

Let your welding operators show you the superiority of Type "F". It will easily prove that its good qualities make welding easy. Type "F" penetrates deeply, flows smoothly, and deposits evenly. Welders like it. Considering, too, that it produces tough, lasting welds and is fairly priced, you also will be convinced that Type "F" is satisfactory from every angle.

Learn more about G-E welding electrodes from the G-E Welding Electrode Distributor near you or write to Section E-5112, Merchandise Department, General Electric Company, Bridgeport, Connecticut

For simplicity, reliability, and ease of operation, G-E arc-welding sets are unequalled. They are available in all sizes, all types—for either hand or automatic operation—for one or more operators.

550-514

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY AT 9 P.M., E.S.T. ON A NATION-WIDE N.B.C. NETWORK

GENERAL ELECTRIC

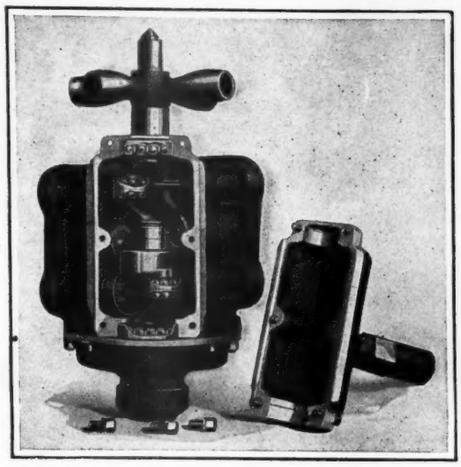
MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

CLECO

BALL BEARING AIR DRILLS

Cleco Motor Construction Reduces Cost of Upkeep

No. 1 GH



CLECO MOTOR ASSEMBLY

The Cleco Motor Assembly shown in the engraving clearly shows the simplicity of design and accessibility to Motor parts of Cleco Air Drills. Every revolving part in the Cleco Air Motor is mounted upon Ball Bearings, this type of construction admits of high speed and minimizes friction.

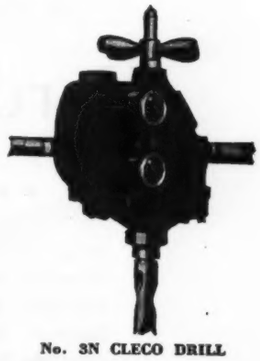
The "One Piece" Ball Bearing Connecting Rods eliminate such non-essential parts as Studs, Nuts, Caps and Toggles entirely, thus reducing up-keep in service and greatly increasing the efficiency of the Air Drill.

No. 1 WH

Cleco Drills have great power in a compact body. They are sturdy in construction and give long service.

Made in 36 styles and sizes, Reversible, Non-Reversible and Compound to suit all classes of work. They are especially adapted to Railroad work.

The No. 3N—Non-Reversible Drill illustrated is a strong and sturdy machine for general work. Weight 41 lbs., Reaming speed 500 R.P.M., capacity 1¼ in. drilling in steel, 1 in. reaming. Fitted with No. 3 M.T. socket, Snap or Twist throttle handle.



No. 3N CLECO DRILL

CLECO PRESSURE-SEATED AIR VALVES

Require No Attention After Installation

Style A.

Cleco Valves: Have but 3 parts—Body, Plug, and Handle, have no Packing, Springs, or Discs.

Cleco Valves: Are made pressure tight by the air pressure itself—air does not touch the seat.

Style R. A.

Cleco Valves: Once installed stop all valve leakage, save time of men repacking valves.

BOWES "QUICK-ACTING" HOSE COUPLING

STANDARD EQUIPMENT EVERYWHERE

Style P. O.

Absolutely Air-Tight under all Pressures

Instantly Connected or Disconnected with ¼-Turn

Style S. R.

Shows Neverslip Clamps Attached to Bowes Couplings

Style L. W.

Write for Catalog No. 27 (Pocket Edition)

Branch Offices in All the Large Cities

Style F. W. L.

THE CLEVELAND PNEUMATIC TOOL CO.,

Cleveland, O., U. S. A.

Agents for British Isles

John MacDonald & Co., Pollokshaws, Glasgow, Scotland

Fig. 106, Jenkins Standard Bronze Globe Valve, screwed, in booster test steam line.

Hard service and hard knocks ... all in the day's work

It is the job of this Jenkins Fig. 106, Standard Bronze Globe Valve to control the flow of steam in the booster test line. Because of the valve's exposed location near the ground, hard knocks are all part of the day's work.

But the inherent strength of Jenkins enables this valve to discharge its duties efficiently. It provides accurate control of the steam flow and easy operation.

The body of a Jenkins bronze valve is cast of pure virgin metal. Spindles are of manganese bronze. Machining is accurate, and threads clean cut.

There is a Jenkins Valve in bronze or iron, in standard, medium or extra heavy pattern for practically every railroad requirement. Obtainable through supply houses.

JENKINS BROS.

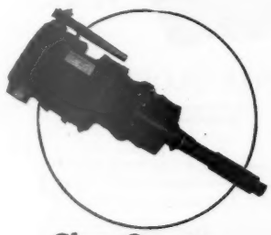
80 White Street, New York, N.Y. 133 No. Seventh Street, Philadelphia, Pa.
524 Atlantic Avenue, Boston, Mass. 646 Washington Boulevard, Chicago, Ill.
JENKINS BROS., Limited, Montreal, Canada; London, England
Factories: Bridgeport, Conn.; Elizabeth, N. J.; Montreal, Canada

Jenkins
VALVES
Since 1864

R-1921

The Class PRE-2 Compressor embodies the noteworthy features of 5-step clearance control regulation and synchronous motor drive

Riveting Hammers



Close-Quarter Drills

"Safety-First" Air Saws

In Step With Increased Railroad Efficiency

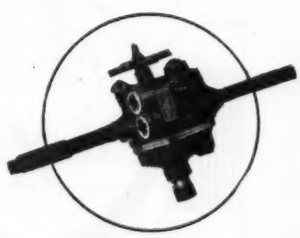
The past year was marked by the greatest operating efficiency ever known by the American railroads. This splendid showing is particularly notable, as the standards of efficiency have been steadily raised year after year.

In line with this progress, Ingersoll-Rand compressors and pneumatic tools have contributed their share in various phases of operation and maintenance. These machines have likewise reached new standards of efficiency and economy of operation. Over fifty years' experience in serving the railroads is built into Ingersoll-Rand equipment.

INGERSOLL-RAND COMPANY

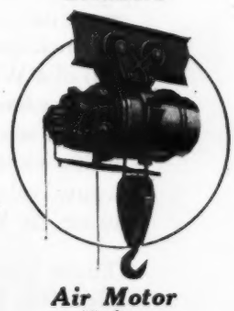
11 Broadway New York City

Branches or distributors in principal cities the world over
For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec.



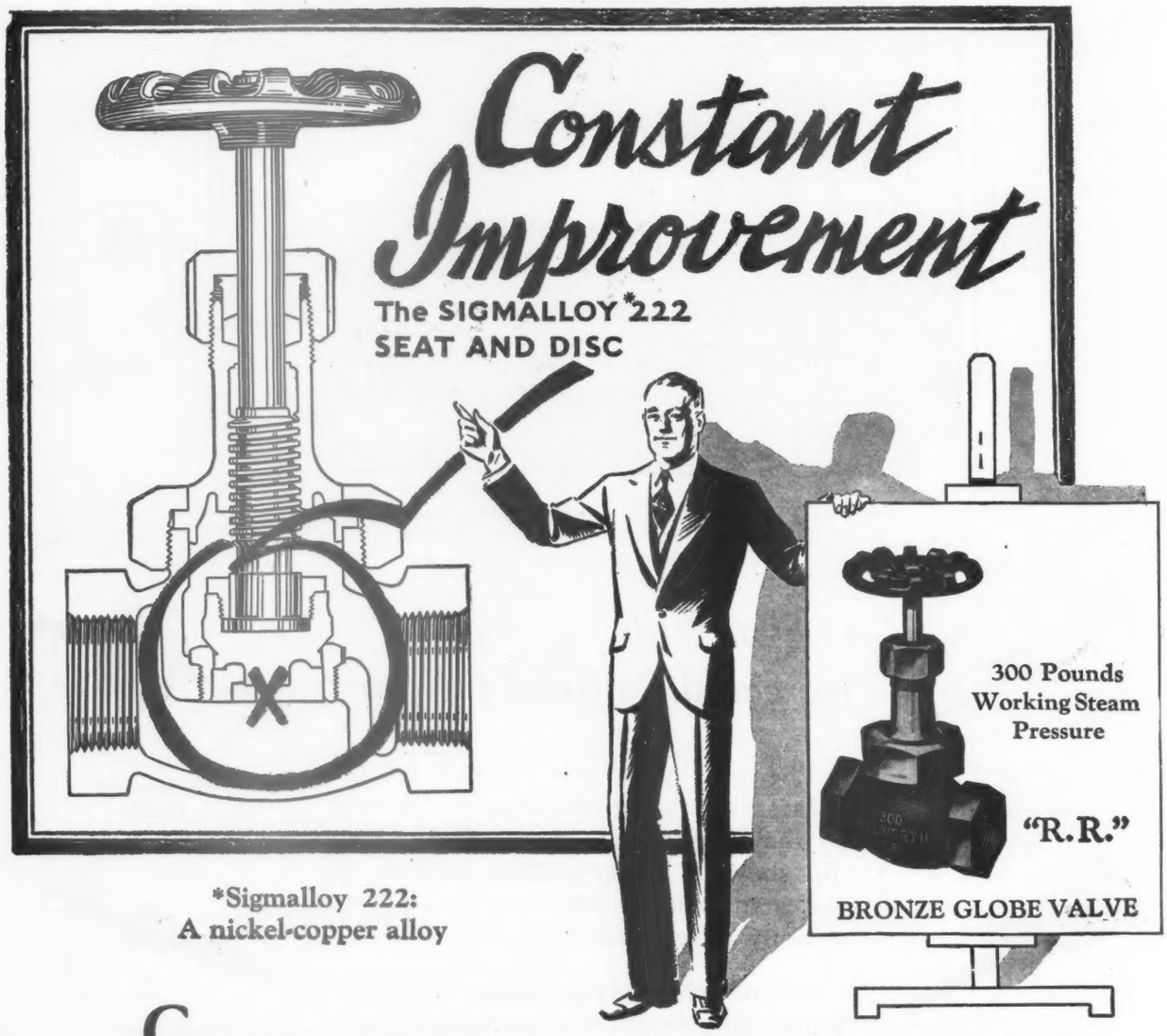
Pneumatic Drills

Rod Grinders



Air Motor Hoists

Ingersoll-Rand



*Sigmalloy 222:
A nickel-copper alloy

CONSTANT improvement—instant interest in new ideas—readiness to meet new conditions as they arise and to anticipate new needs—that is the job of a Walworth engineer. The fact that he has performed it well and with a keen sense of its increasing responsibility explains why men who really know valves are turning more and more to Walworth.

There is scarcely an item in the complete line of Walworth valves, fittings and pipe tools that has not been vitally improved in recent years. Changes in design, construction, finish: better methods of testing: new materials—all these cumulative improvements have played their part in keeping the Walworth line in the position of leadership.

* * *

Among the valves that Walworth makes is this 300 lb. Bronze Globe Valve, (with a renewable and regrinding Sigmalloy 222* seat and disc) which for strength and sheer ability to stand up under severe service conditions, has built a reputation wherever valves are known.

WALWORTH

Walworth Company, General Sales Offices: 51 E. 42nd St., New York
Plants at Boston, Mass.; Kewanee, Ill.; Greensburg, Pa.; and Attalla, Ala.

. . . Distributors in Principal Cities of the World . . .

Walworth Company Limited, 620 Cathcart St., Montreal, P. Q.
Walworth International Co., 11 Broadway, New York, Foreign Representative

FOR FASTENING SHEET METAL TO WOOD

A nail doesn't hold and bends or breaks

A screw is too costly and difficult to use

. . . so

here is the Screwnail

...with 4 times the holding power of ordinary nails
...made so that it will not bend or break

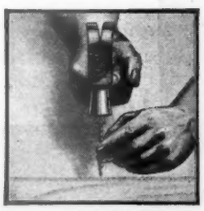
BOTH common nails and wood screws are unsatisfactory makeshifts for fastening sheet metal to wood. You'll agree, though, that a combination of both would give you an ideal device for such work—a device that would drive like a nail, but hold like a screw.

Here it is—the Hardened Screwnail! Combines the driving qualities of a nail and the holding qualities of a screw. Designed expressly for fastening sheet metal to wood.

You can drive a Screwnail through sheet metal into wood much more easily and quickly than a common nail because of the hardened needle point. And having great tensile and shear strength it does not bend or break readily like a common nail.

Once in, the Screwnail *stays in.* It will not back out or pull out or loosen. Laboratory tests prove that Screwnails have over 4 times the holding power of ordinary nails.

Railroad shops everywhere are finding this new Nail superior for every job where sheet metal must be securely fastened to wood. Try them on your own work—we'll provide free samples for a test. Just tell us what you want to fasten.

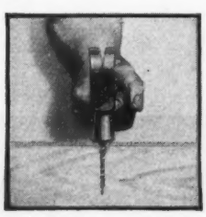


1. No need to punch a hole...sharp needle point pierces sheet metal with ease.

PARKER-KALON CORPORATION
202-204 Varick Street New York, N.Y.

PARKER-KALON
HARDENED
*Screw*nails

PATENTED JAN. 29, 1924-No. 1482151
OTHER PATENTS PENDING



2. Hardened spiral thread forms a thread in sheet metal and wood. Anchors sheet metal securely to wood.

Bar Iron that Bars None

The remarkable ability of Genuine Puddled Wrought Iron to withstand constant strain and vibration, while defying the forces of corrosion, makes it the ideal material for stay-bolts and engine bolts, bar none.

Reading Bar Iron is Genuine Puddled Wrought Iron—produced in the time-tested way by working together fiery, pure pig iron and silicious slag inside a puddling furnace. Graded with exceptional care, Reading Bar Iron gives you the proved reliability that no substitute can have.

You'll find no "maybe" in the performance or endurance of Reading Bar Iron. The name "Reading" is your guarantee of Genuine Puddled Wrought Iron.

Reading Bar Iron is furnished in the following sizes: Rounds ½" to 4½" in diameter. Squares ½" to 4". Flats 1" x ¼" to 10" x 2". Half Rounds ⅞" to 1½".

READING IRON COMPANY, Reading, Pennsylvania

Atlanta · Baltimore · Cleveland · New York · Philadelphia
Boston · Cincinnati · St. Louis · Chicago · New Orleans
Buffalo · Houston · Tulsa · Seattle San Francisco
Detroit · Pittsburgh · Ft. Worth · Los Angeles
Kansas City

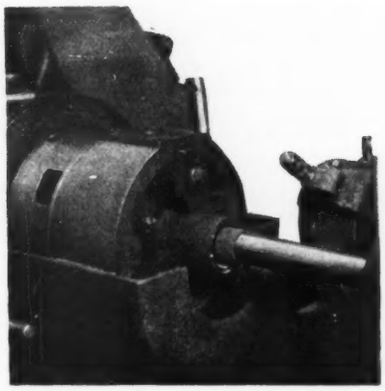
READING BAR IRON

GENUINE PUDDLED WROUGHT IRON

EVERY BUSHING— *Round and True*

HEALD

SIZE-MATIC GRINDER



THE Heald Internal Size-Matic Grinding Machine turns out bushings uniformly perfect thereby eliminating spoilage due to misfits. This is made possible by an automatic wheel truing device which is shown in working position in the above illustration. The wheel is trued just before the finish cut is taken giving an exacting finish to each bushing without taper, out of roundness or bell mouth.

We will be pleased to send you complete information.

THE HEALD MACHINE CO.
Worcester, Mass.

air power cuts the cost, and electricity serves new millions

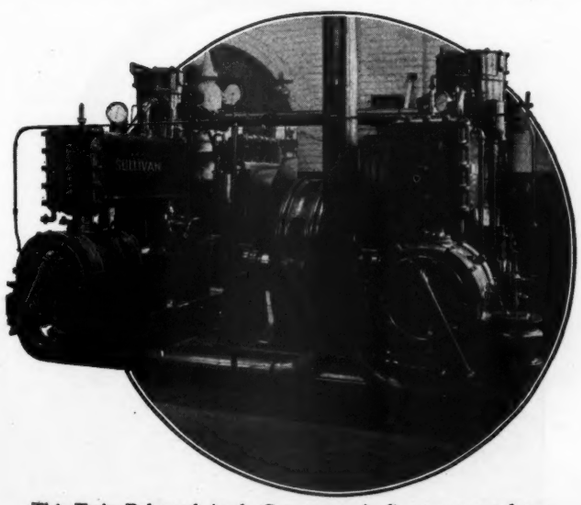
A COST cut on an electrical product may bring a million customers. A million new buyers in industry—or a million new families who wash, iron, sew, clean, refrigerate or exercise, electrically.

Production processes and machines set the growth of the electrical industry. They are adopted, when they prove they can cut costs —and today, builders of two-thirds of America's electrical equipment use air power from Balanced Angle Air Compressors.

In the plant illustrated, two twin Balanced Angle Compressors were bought first. Then a third, a fourth, a fifth, followed in quick succession.

While air proved its economy on a swiftly-growing list of uses—Balanced Angle Compressors proved their economy in power, maintenance, and floor space. They have proved their economy to leaders in every industry. They will prove it to you.

Why not send now for Catalog 83-J?

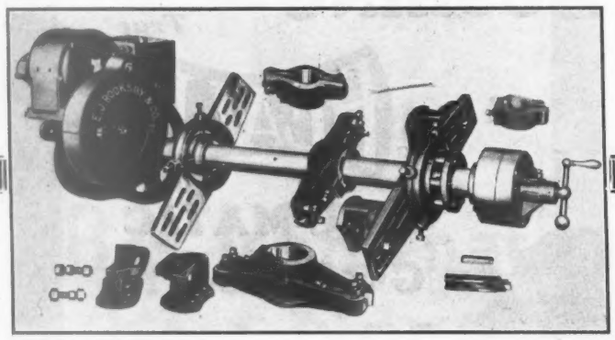


This Twin Balanced Angle Compressor is direct connected to a synchronous motor, mounted on its own bearings and its shaft coupled to those of the compressor. Either compressor can be operated alone, in slack periods.

BALANCED ANGLE COMPOUND SULLIVAN

S U L L I V A N TRADE MARK

Sullivan Machinery Company
706 Wrigley Bldg., Chicago



Quicker And More Accurate

ONE railroad reports a 50% savings over previous performance since the installation of ROOKSBY Motor Driven Cylinder Boring Bars.

"We only take one cut now" said the General Foreman "whereas before, two were necessary to insure accurate jobs."

"The smooth, powerful drive permits the use of heavy cuts at maximum speeds—"less time is required for set-ups and the work is perfect."

If you are interested in reducing the cost of boring cylinders, investigate the time saving features built into ROOKSBY Motor Driven Boring Bars.

E. J. Rooksby & Company

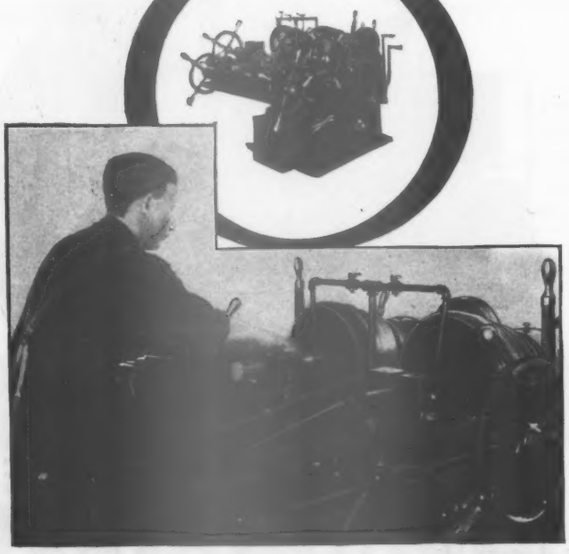
Manufacturers of Portable Tools for locomotives

1072 Hamilton St. Philadelphia, Pa.

ROOKSBY Portable Tools

The 1¼-inch head threads bolts from 3/8 to 1¼-inch; the 2-inch head, from ½ inch to 2 inches. Two different sizes can be threaded at the same time.

Dies used are substantial but small and inexpensive, showing a big saving in die costs.



8 spindle speeds for each head—

your operator can get the machine's *maximum* speed on every size bolt that's threaded

You immediately get an increase in your bolt threading production—and a cut in threading costs—when you start using the Williams Double-Head "Rapiduction" Bolt Threader.

With 8 spindle speeds, and a separate gear box and clutch control for each head, your operator can instantly get the best speed for each size bolt—the machine's *maximum* on every size. Making a big saving in time—*increasing threading production as much as 40%.*

And note the handy dual controls, on each side of the machine. Operator has instant control from any position; a time saver.

A very sturdy machine, quality construction throughout—with machine cut gears running in oil bath, bronze bushings, etc.

Write for Bulletin giving full description.

Williams Tool Corporation

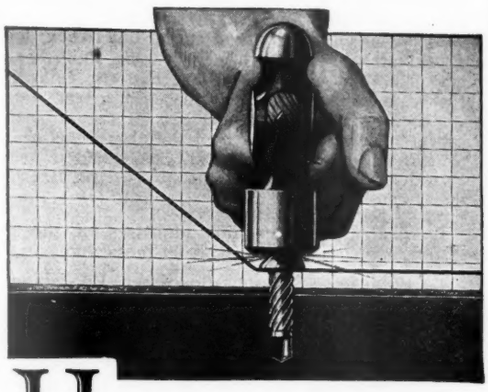
Canadian Plant: Brantford, Ontario

WILLIAMS BOLT THREADER

1213 Liberty Street, Erie, Pa.

PIPE, NIPPLE & BOLT THREADING MACHINES

ELIMINATE TAPPING WITH THESE UNIQUE SCREWS



Hammer down metal assembly costs

... by hammering in this Screw that makes secure fastenings without tapping .....

When Hardened Metallic Drive Screws are adopted for an assembly, the costly, time-wasting items that make assembly costs climb are banished.

Tapping is eliminated. So are broken taps, tapping plates, tapping machinery maintenance, and stripped and crossed threads that result in scrapped parts and materials.

No need for skilled workmen, either. Any man can make permanent fastenings to iron, brass and aluminum castings, steel, Bakelite, etc., with Hardened Metallic Drive Screws. Nothing could be easier, quicker or cheaper.

Just hammer the Screw into a drilled or molded hole. It cuts its own thread in the material and binds the sections so securely that the fastening holds under vibration and severe service.

Many well known Roads have tested and adopted these Screws. Try them on your own work—we'll furnish samples, free.

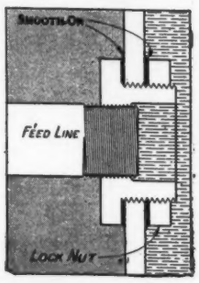
PARKER-KALON CORPORATION
202-204 Varick Street New York, N. Y.

Distributed in Canada by
Aikenhead Hdw., Ltd., 19-21 Temperance St., Toronto

PARKER-KALON
TRADE MARK
HARDENED METALLIC
REG U.S.PAT OFF.
DRIVE SCREWS
PAT. JAN. 29, 1924 No. 1482151 - OTHERS PENDING

For Making Fastenings to Iron, Brass and Aluminum Castings, Steel, Bakelite, etc.

TO STOP LEAKAGE PERMANENTLY AT TAPPED CONNECTIONS



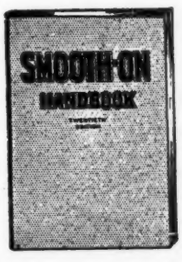
SERIOUS leakage developed where the feed line joined one of the boilers in a large Milwaukee manufacturing plant. The brass spud used to bring the line through the tube sheet was loose and could not be tightened, as it had been turned up to the end of the threads, and the under shoulder was tight against the boiler metal.

The Engineer knew from past experience with many Smooth-On repairs that this loose spud could be made perfectly tight and permanently free from leakage.

Here is how he did it:—The spud was removed and a generous coating of Smooth-On No. 3 was applied to the faulty threads. In reassembling, a layer of Smooth-On No. 1 was put between the boiler metal and the spud shoulder. Inside the same mixture was applied all around the projecting threads, and squeezed tightly against the tube sheet by a lock nut as shown in the diagram. When this repair was brought to our attention sixteen months later, it had never leaked a drop and the bond was as strong as when the original joint was new.

Almost any kind of leakage at joints, cracks and porous spots in pressure containers can be stopped at small cost by applying Smooth-On in accordance with the directions in the Smooth-On Handbook.

Get the Smooth-On Handbook by mailing the coupon, and get Smooth-On in 1 or 5-lb. can or larger keg from your supply house or if necessary direct from us.



The SMOOTH-ON HANDBOOK FREE

If you return the coupon

Twentieth Edition—136 pages of data—193 diagrams, pictures and practical hints on at least 200 different uses for SMOOTH-ON. Every progressive engineer should have this book—get your copy NOW.

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO.,
Dept. 32, 570 Communipaw Ave.,
Jersey City, N. J.

Please send copy of the SMOOTH-ON Handbook, Twentieth Edition.

Name .....
Address .....
12-29 .....

Who-o-o-m goes the noon whistle

Switches pulled---clutches thrown---the men quickly throw down their caps and jackets, it is lunch time---a sudden stillness follows the racket and clatter---a distant laugh and shout ---and the dust settles down.

Good men they are, every one, and your greatest asset. Make their work easier and better with proper tools.

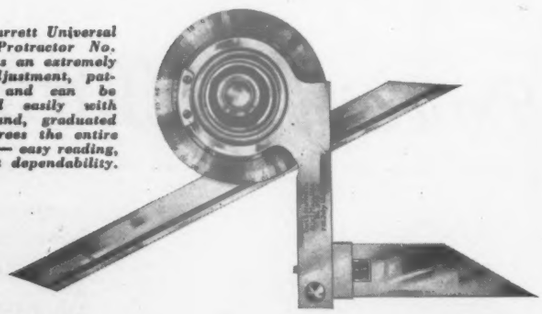
There's pardonable pride in work done when using Starrett Tools.

The Starrett Catalogue No. 24 G F, describing over 2500 Starrett Tools, has come to be regarded as the standard reference book. Sent on request.

THE L. S. STARRETT CO.

World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes - Standard for Accuracy
ATHOL, MASS.

The Starrett Universal Bevel Protractor No. 359 has an extremely fine adjustment, patented, and can be handled easily with one hand, graduated in degrees the entire circle — easy reading, Starrett dependability.



Use Starrett Tools

3505

STATEMENT of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of *Railway Mechanical Engineer*, published monthly at East Stroudsburg, Pa., for October 1, 1929.

State of New York }
County of New York } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. A. Simmons, who having been duly sworn according to law, deposes and says that he is the President of the Publisher of *Railway Mechanical Engineer*, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Simmons-Boardman Publishing Co., 30 Church St., New York, N. Y.

Editor, Roy V. Wright, 30 Church St., New York.

Managing Editor, C. B. Peck, 30 Church St., New York.

Business Manager, Robert E. Thayer, 30 Church St., N. Y., N. Y.

2. That the owners are: Simmons Boardman Publishing Company, 30 Church Street, New York, N. Y. Stock owned by Simmons-Boardman Publishing Corporation, 30 Church Street, New York, N. Y. Stockholders of 1 percent or more of the total amount of stock are: I. R. Simmons, 1625 Ditmas Ave., Brooklyn, N. Y.; P. A. Lee, Hopatcong, N. J.; H. Anderson, 246 Rugby Road, Brooklyn, N. Y.; E. G. Wright, 398 N. Walnut Street, E. Orange, N. J.; S. O. Dunn, 105 West Adams Street, Chicago, Ill.; C. E. Dunn, 3500 Sheridan Boul., Chicago, Ill.; B. L. Johnson, 105 W. Adams Street, Chicago, Ill.; W. A. Radford, 407 So. Dearborn Street, Chicago, Ill.; L. B. Sherman, 375 Sheridan Road, Winnetka, Ill.; Mae E Howson, 6922 Paxton Ave., Chicago, Ill.; Spencer Trask & Company, 25 Broad Street, N. Y. Partners of Spencer Trask & Company are: E. M. Bulkley, Acosta Nichols, Cecil Barret, J. Graham Parsons, C. Everett Bacon, William R. Basset, F. Malbone Blodget, Percival Gilbert, Harry S. Allen, Harry A. Minton, Robert Mallory, William Beckers, all of 25 Broad Street, New York, N. Y.; Arthur H. Gilbert, 308 LaSalle St., Chicago, Ill.; S. Wallace Roe, 253 State Street, Albany, N. Y.; William E. Stanwood, 50 Congress Street, Boston, Mass.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustee, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

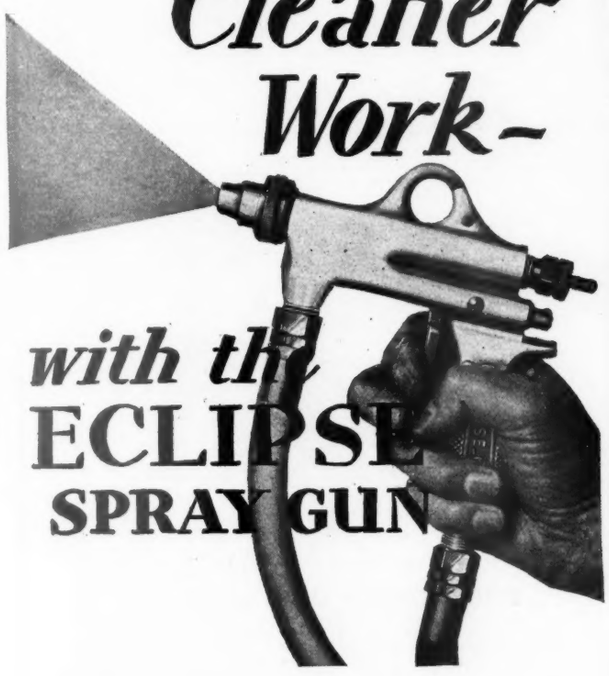
Simmons-Boardman Publishing Co.
E. A. Simmons, President.

Sworn to and subscribed before me this 30th day of Sept., 1929.

H. D. Nelson.

Seal (My commission expires March 30, 1931.).

Faster Cleaner Work-



with the ECLIPSE SPRAY GUN

There are sound reasons why the Eclipse Spray Gun does faster, cleaner work, at less cost of materials and labor.

The simple, rugged construction of the gun, with only three parts to wear, appeals to all good workmen.

Extremely light trigger pull makes Eclipse spraying almost effortless. Absence of strain and undue physical exertion enables operator to do more and better painting in any given time.

Eclipse Low Pressure operation applies paints, lacquers or varnishes correctly with greater impregnation and less loss of materials from evaporation or spattering.

Challenge us to prove Eclipse superiority for your painting operations. A line from you will bring a line from us arranging a demonstration, without obligation.

ECLIPSE AIR BRUSH Co.
79 ORANGE ST. NEWARK, N.J.

CRAFTSMANSHIP

A characteristic of the beaver and also of the skillful workmen who manufacture the products of The Garlock Packing Company, Palmyra, N. Y.

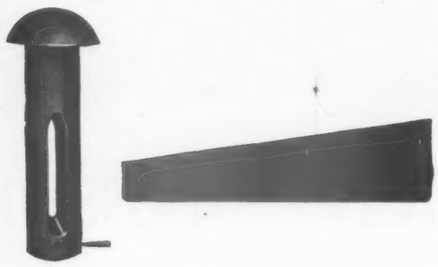
FELLING good-sized trees with their chisel shaped teeth, little beavers construct dams across streams with almost superhuman intelligence. After making their own "beaver pond" by backing up the water, they carefully select sticks, stones and mud with which to build their lodges at the edge of the pond. When completed, these "houses" are sufficiently strong and durable to withstand all the natural hazards of the locality in which they are situated. The entrances are under water—unseen and fully protected.

The mechanical ingenuity of the engineers and skilled workmen who build Quality Controlled Packings is not unlike the inherent craftsmanship of the beaver. Garlock trained craftsmen select all their crude materials with the greatest care by subjecting them to the most rigid laboratory tests. The basic quality of Garlock Packings is thus insured before the ingredients enter manufacture . . . and when completed the finished packings will give complete satisfaction on the intended installation as they are of a design and structure to meet its requirements.

REDUCE YOUR BOLTING EXPENSE ONE-HALF BY USING OUR

Special Fitting Up Bolts

ALL SIZES—ANY LENGTH



KEY-BOLT APPLIANCE CO.

Manufacturers

Factory and Offices
Elmira, New York
U. S. A.

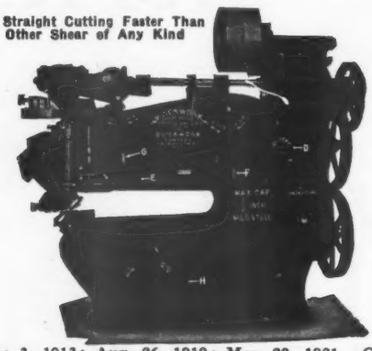
"QUICKWORK"
(TRADE-NAME REGISTERED THROUGHOUT THE WORLD)

ROTARY SHEARS
MADE IN VARIOUS SIZES AND STYLES

For cutting all gauges of sheet and plate up to 1 inch thick used in building Ships, Boilers, Cars, Tanks and General Plate and Sheet Metal Work. Cut square or beveled edges in straight or irregular shapes, also cut rings and discs, and cut openings without starting in from side of sheet. Leaves the metal flatter than any other Rotary or Short-Straight-Bladed Shear. Cuts a clean edge that requires no finishing.

Joggling and flanging rolls can be used interchangeably with the cutters.

Do Long Straight Cutting Faster Than Any Other Shear of Any Kind

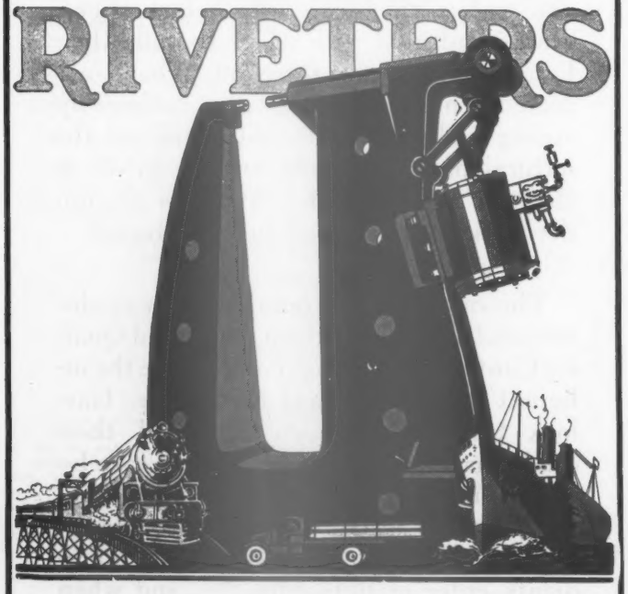


Pat. June 3, 1913; Aug. 26, 1919; Mar. 29, 1921. Other patents pending. One "QUICKWORK" does the work of a number of old style machines. Does it better and from two to ten times quicker.

Eliminate Oxy-acetylene Cutting and Plate Planing
WRITE FOR CATALOG No. 80.

THE QUICKWORK COMPANY
(Not Incorporated—H. Collier Smith, Owner)
St. Mary's, Ohio, U. S. A.
Cable Address: "QUICKWORK." All standard codes used.
New York Exhibit: Grand Central Palace.
Agent for British Isles: Oliver Machinery Co., Manchester, England

RIVETERS



THERE IS A HANNA RIVETER TO MEET EVERY CONDITION

HANNA ENGINEERING WORKS
1765 ELSTON AVE., CHICAGO

Selling the Man Your Salesman Never Sees

Big orders are often lost because the man your salesman sees can't resell the proposition to some man your salesman doesn't see.

In some household, some inner sanctum, some director's room, some banker's private office the decision goes against you without your ever having had a chance to present your case.

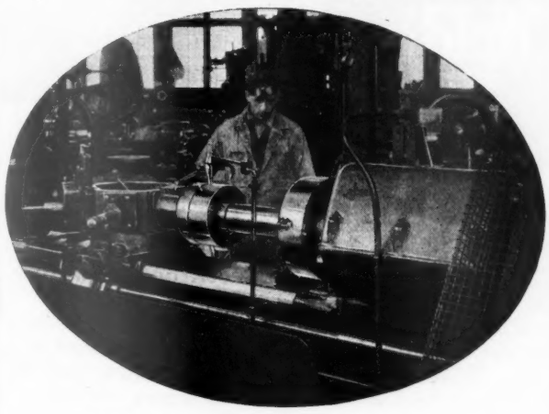
Into these blue pencil rooms where salesmen seldom penetrate advertising goes whenever you choose to send it.

Because of this it sometimes pays to use widespread advertising to influence a comparatively small number of people. Though 95 per cent of the readers of the publication may never be in the market for your product, the value of reaching the other 5 per cent may be so great as to justify the cost.

[Published by Ry. Mech. Eng. in co-operation with The American Association of Advertising Agencies]

100 lb. Bolts

as easy as ½" Cap Screws



This Style D Die Head is threading these 100 lb., 4-½" Bolts as easy as you'd thread a ½" Cap Screw.

This is the kind of a Die Head you need in a Railroad Shop. Many shops are already so equipped.

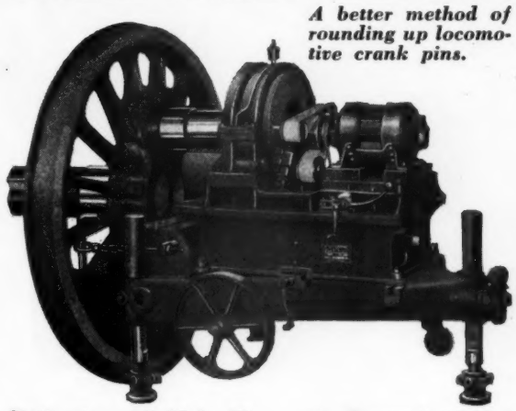
Can we give you further facts?

THE GEOMETRIC TOOL COMPANY
New Haven, Conn.

GRINDERS Micro **The MICRO**

Portable Crank Pin Grinder

A better method of rounding up locomotive crank pins.

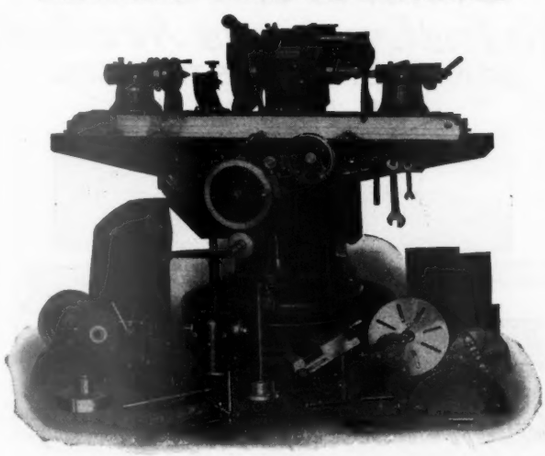


Both steps of Main Pins, out of round 1/16" to 1/8", are ground to absolute accuracy with the MICRO in approximately two hours. Single diameters (Side Rod Pins) ground in approximately one and one-quarter hours. How does this time compare with your present methods? Ask for details.

MICRO MACHINE COMPANY
Bettendorf — MANUFACTURERS AND DESIGNERS OF PRECISION GRINDERS FOR ALL PURPOSES — Iowa, U-S-A

THOMPSON

—12" x 36"—
UNIVERSAL GRINDING MACHINES



SEPARATE COUNTERSHAFT DRIVEN

ALSO SELF-CONTAINED, MOTOR DRIVEN

Equipped with fine cross feed for Cylindrical grinding, and independent coarse cross feed for Surface grinding.

Write for information on Radius Attachment for grinding corners on channelling Cutters.

THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO
1534 West Main Street

LIBERTY FROM SMALL TOOL TROUBLES

If quality wasn't such a necessary factor in the manufacture of Cleveland Small Tools, we'd spend less time in the making and quote lower prices.

It's mistaken economy to purchase Small Tools on price alone when Quality Small Tools cost but little more.

Specify Clevelands on your next order and "Let your scrap heap be your guide."

THE CLEVELAND PUNCH & SHEAR WORKS CO.
CLEVELAND OHIO, U.S.A.

Ashton Wheel Press Recording Gages

Ashton Wheel Press Recording Gages give an accurate record of wheel fits on axles, showing actual fit from start to finish, insuring perfect mountings.

Send for special circular which gives full details, also catalogue describing our complete line of Specialties.

The Ashton Valve Co.

BOSTON, MASS. NEW YORK CHICAGO, ILL.
161-179 First St., Cambridge 126 Liberty St. 565 W. Washington Bld.
SAN FRANCISCO, 606 Howard St. 4

Good Welding Wire

Saves . . . welding labor

PAGE *Processed* Welding Wire and Electrodes take the guesswork out of welding.

Uniform results can only be obtained from uniform welding wires and electrodes. Page Wires and Electrodes are *processed* and shop tested to assure uniform welding qualities.

PAGE STEEL *and* WIRE COMPANY
General Sales Office: New York Central Building, 230 Park Avenue, New York, N. Y.
An Associate Company of the American Chain Company, *Inc.*, Bridgeport, Conn.
District Offices: New York, Pittsburgh, Chicago, San Francisco
Canadian Distributor and Manufacturer: Frost Steel and Wire Co., Limited, Hamilton, Ontario

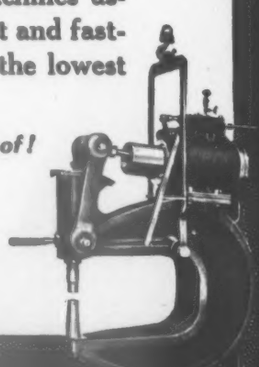
PAGE-ARMCO
FLAME TESTED PROCESSED SHOP TESTED
Welding Wire and Electrodes

ALLEN RIVETERS

First in the field and built for uniform and long service the "ALLEN" machines assure the tightest and fastest riveting at the lowest cost.

Ask us for proof!

John F. Allen Company
372 Gerard Ave.
New York

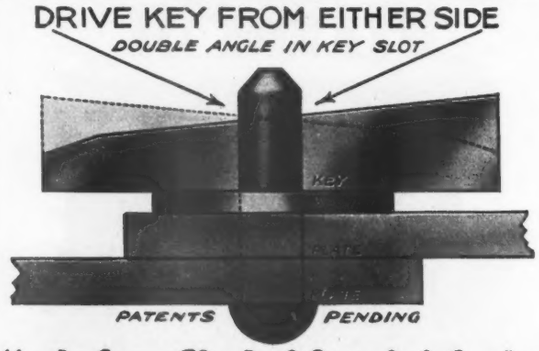


New Process KEY BOLTS

FOR "FITTING-UP" PURPOSES

No Instructions Needed

DRIVE KEY FROM EITHER SIDE

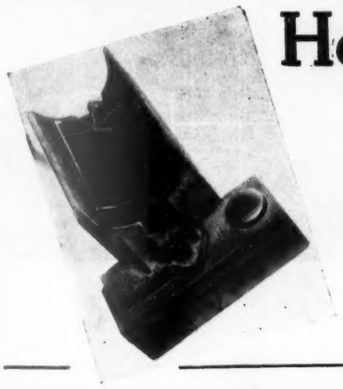


Made from Steel of Special Analysis

— Hold Tighter —

— Last Longer —

McKAIG-HATCH INC.
MANUFACTURER
BUFFALO, N. Y.-U. S. A.



Hennessy Journal Lubricator

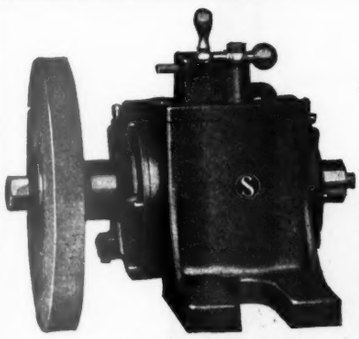
Engine Truck and Driving Journal Type

EASY to apply—takes the place of the standard cellar; lateral motion of wheels operates pump which delivers oil of any consistency thus insuring perfect lubrication of journal and hub faces at all times. Prevents hot journals, reduces bearing and journal wear and lowers repair costs. In use for over five years on the heaviest equipment on some of the largest roads in United States. Permits continuous locomotive operation without inter-terminal attention.

Write for complete information

J. J. HENNESSY

136 Liberty St. HENNESSY LUBRICATOR New York, N. Y.



PARALLEL GRINDERS

STANDARD

"POWER-PLUS" BALL BEARING GRINDERS

MADE IN ½, 1, 2 AND 3 H.P. SIZES

For grinding rolls, journals, connecting rods, bushings and parallel work of every description. Vertical adjustment 4 to 6 inches, depending upon size. Angle plate can be bolted to planer, boring mill, lathe, shaper and various machine tools.

GENERAL ELECTRIC UNIVERSAL MOTOR AERIAL GRINDER

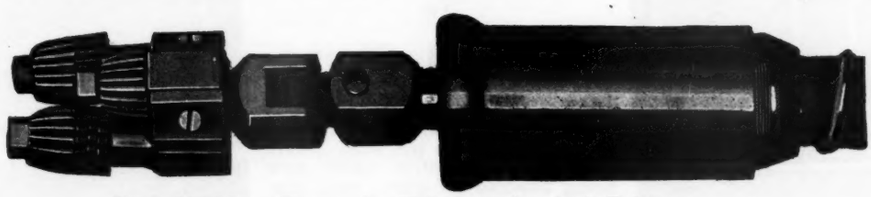
Operates on both A. C. and D. C. of same voltage. Trigger Switch. S. K. F. Ball Bearings. Full ball bearing throughout.

Made in two sizes carrying 5" x ¾" wheels and 6" x 1" wheels.

These are valuable tools for grinding rough castings, welded metal and general grinding and buffing.

Established 1912 **THE STANDARD ELECTRICAL TOOL CO., Cincinnati, Ohio** *1948 West Eighth St.*

ROTO LOCOMOTIVE ARCH TUBE CLEANERS



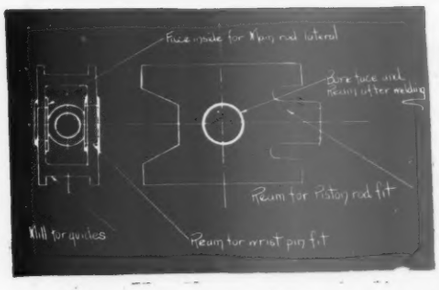
Roto Air-driven Cleaner for 3" Locomotive Arch Tubes

THE ROTO COMPANY **NEWARK, N. J.**

Have You Changed Your Address?

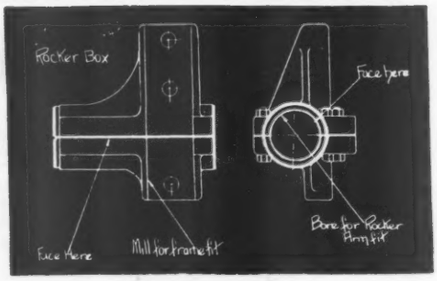
Notice of change of address of subscribers should reach the office of Railway Mechanical Engineer, 30 Church St., New York, ten days in advance to insure delivery of the following issue to new address. In sending notification of change always include the old address as well as the new.

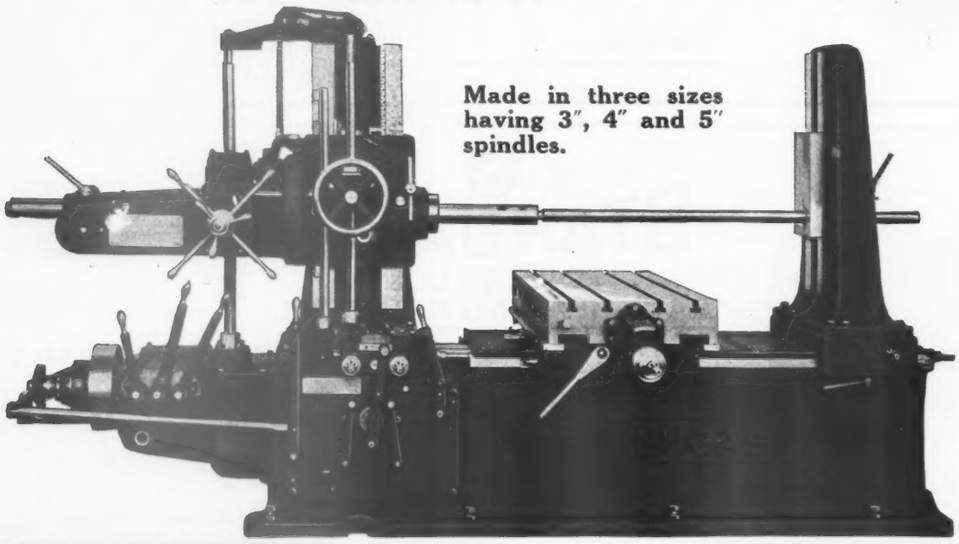
Name ..... **Old Address** .....
New Address .....
..... **Position** ..... **Company** .....


Face inside for Main rod lateral
Bore face and ream after welding
Ream for Piston rod fit
Mill for guides
Ream for wrist pin fit

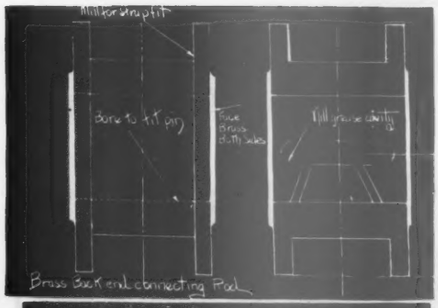
THE LUCAS Precision

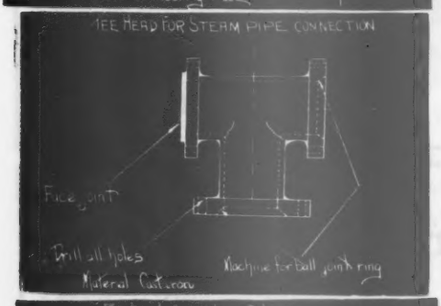
Horizontal, Boring Drilling and Milling MACHINE

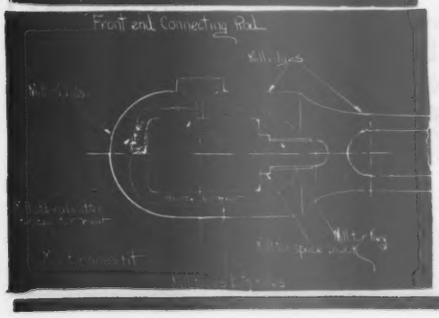




Made in three sizes having 3", 4" and 5" spindles.







Saving Set-ups

in

Railroad Shops

ADAPTABILITY to all classes of work makes the Lucas the busiest machine in the shop. There are many locomotive parts, now being handled on other units that can be machined more economically on the Lucas.

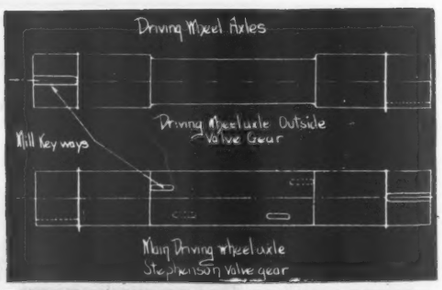
Machining crank pins, crossheads, connecting rods, connecting rod brasses, rocker boxes, driving boxes, driving wheel axles and crossheads as shown on the miniature blue prints are excellent examples of regular every day money saving Lucas jobs.

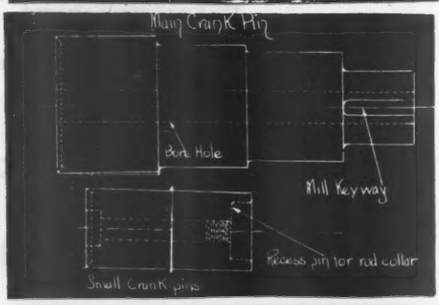
The machine operations on these jobs are performed with only one set-up thereby saving considerable time and labor over ordinary methods requiring two or more set-ups.

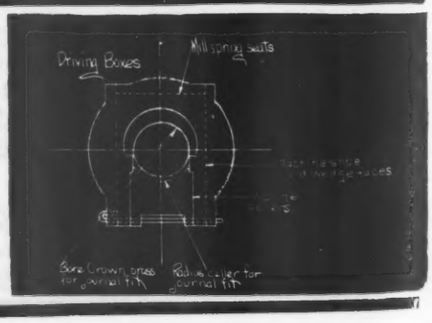
Write for circular B-2. It explains the details and many advantages of these new, faster, larger, more rigid, powerful and convenient machines.

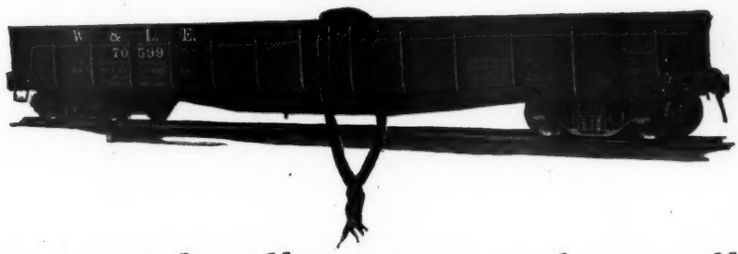
The Lucas Machine Tool Co.

Cleveland - Ohio









Eliminating the "corrosion factor" cuts a ton from "dead" weight

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This, in view of the slight additional cost of Toncan, results in a worth while increase in earning power.

TONCAN COPPER Mo-lyb-den-um IRON

Toncan Iron Tubes
Toncan Iron Rivets
Toncan Iron Staybolts
Toncan Iron Firebox Sheets
Agathon Alloy Steels For Locomotive Parts
Agathon Engine Bolt Steel
Agathon Staybolt Steel

CENTRAL ALLOY STEEL CORPORATION

Massillon, OHIO

World's Largest and Most Highly Specialized Alloy Steel Producers

Makers of Agathon Alloy Steels

Cleveland Detroit Chicago New York St. Louis
Syracuse Philadelphia Los Angeles Cincinnati
San Francisco Seattle

Export Office: New York Central Building, New York, N. Y.

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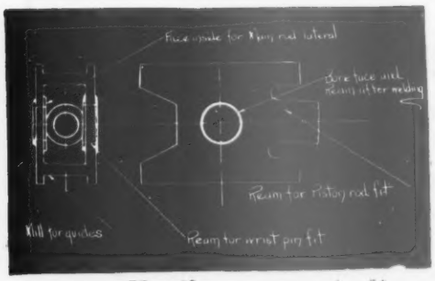
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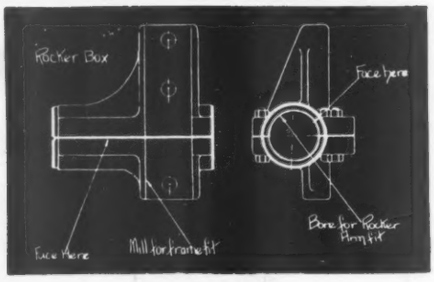

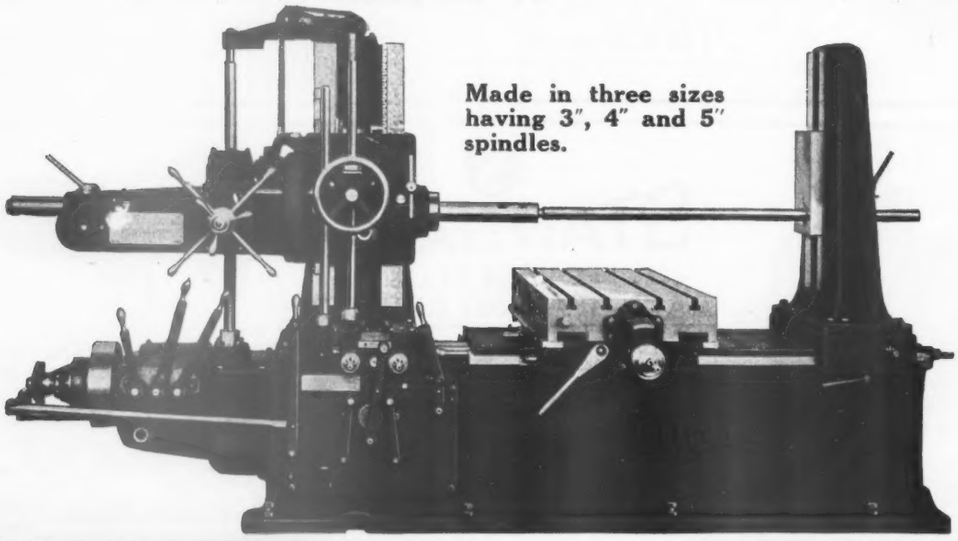

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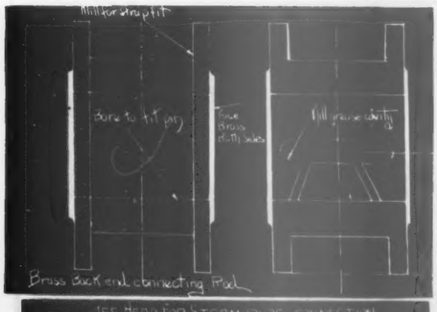
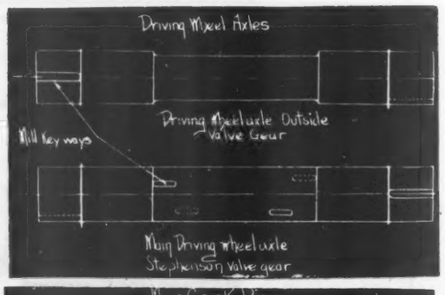
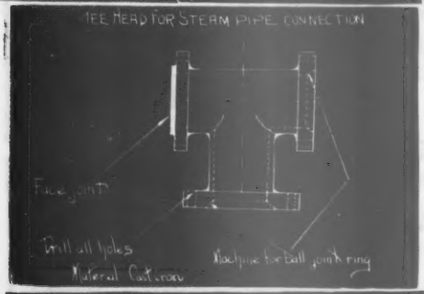
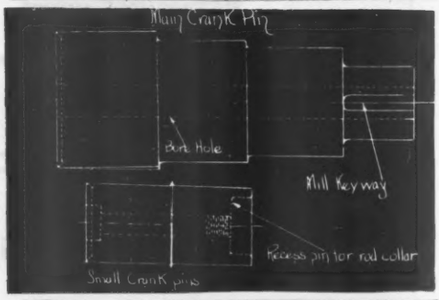
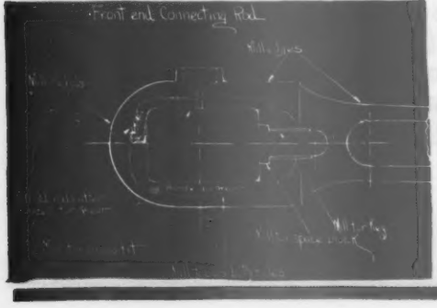


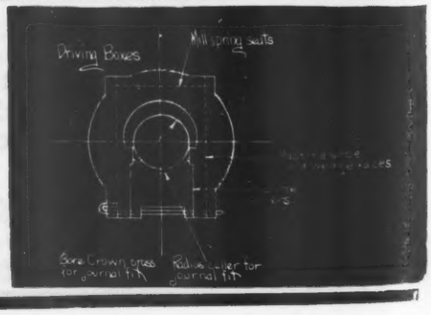


Saving Set-ups in Railroad Shops









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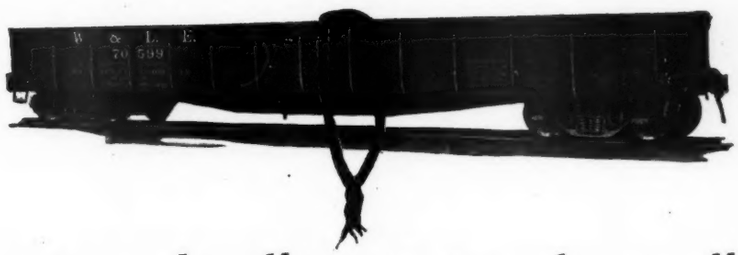

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Makers of Agathon Alloy Steels

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Syracuse Philadelphia Los Angeles Cincinnati
San Francisco Seattle

Export Office: New York Central Building, New York, N. Y.

TONCAN COPPER MO-LYB-DEN-UM IRON

PROGRESS

"THE number of locomotives retired in the seven years ending with 1928 was 19,960, or almost 31 per cent of the number in service at the beginning of this period.

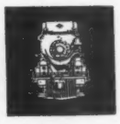
"The best service and the greatest efficiency and economy of operation can be secured only with a railway plant that is constantly undergoing transformation through the retirement of its old and obsolete parts, and the substitution of the most modern and highly improved facilities."

—Editorial from the *Railway Age*.

The present intensive operation of railroads calls for locomotives of high sustained horse-power. These locomotives must be "light" on fuel, must be able to run continuously for long distances, must be easy on the track, must be readily maintained and always be available for service, and must fit into the widely varying demands of modern railway traffic.

These qualities are highly developed in the Lima Super-Power Steam Locomotives. More of them are needed to replace "outdated", inadequate engines still in service.

Super-Power Steam Locomotives

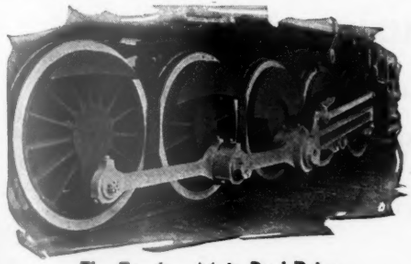


LIMA LOCOMOTIVE WORKS
Incorporated
LIMA, OHIO

Lower Rod Maintenance On Big Power

THE increased stresses put upon rods by Super-Power locomotives threatened to run up maintenance until the advent of the Tandem Main Rod Drive.

In this construction, instead of continuing to enlarge the main pin to meet increased piston thrusts, thereby increasing bearing pressures; the work has been distributed over four outside main crank pins and two axles.



The Tandem Main Rod Drive

In effect there are two main rods, one behind the other, connected to two main pins. Work of the main pin has been reduced 25 to 50 per cent. depending on the number of drivers. Rod and axle bearings therefore run for much longer periods without maintenance.

FRANKLIN RAILWAY SUPPLY COMPANY, Inc.

NEW YORK CHICAGO SAN FRANCISCO ST. LOUIS MONTREAL

STOP THIS!

You won't have to change steam hose on cars equipped with

BARCO
Steam Heat Connections

6 points about Barco Steam Heat Connections

1. A connection that will carry the steam without leaking.
2. Gaskets that last a year and cannot blow out.
3. All steel construction provides greater strength and can be straightened or welded in case of accident.
4. Full area capacity all positions without sharp bends, requiring less steam from locomotive.
5. Fully insulated and the insulation protected with steel jacket.
6. Minimum number of parts—reduced maintenance.

Barco Manufacturing Company

1801 Winnemac Avenue, Chicago, Illinois

The Holden Company, Ltd.

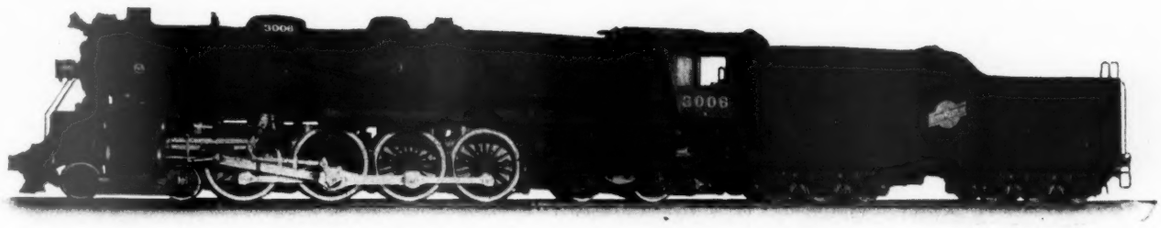
In Canada Montreal, Moncton, Toronto

In Canada Winnipeg, Vancouver

RME 12-Gray

BALDWIN

Highly Developed 4-8-4 Type Locomotives for the Chicago & North Western



One of the New 4-8-4 Type Locomotives for the Chicago & North Western

E. B. HALL, GENERAL SUPERINTENDENT MOTIVE POWER AND MACHINERY

Cylinders	27" x 32"	Superheating surface	2357 sq. ft.
Drivers, diameter	76"	Weight on drivers	288,000 lb.
Steam pressure	250 lb.	Weight, total engine	498,000 lb.
Grate area	100 sq. ft.	Tractive force, main cylinders	65,200 lb.
Water heating surface	5214 sq. ft.	Tractive force, with booster	76,500 lb.

THE highest development of the 4-8-4 type yet produced is found in 35 locomotives now being built for the Chicago & North Western by The Baldwin Locomotive Works. Suitable for either fast freight or heavy passenger service, they are designed to develop maximum efficiency and capacity, keeping weights and dimensions within the limits specified.

This design represents the joint work of the Railway Company and the Builders. The boiler and machinery are constructed to permit a working pressure of 275 pounds, should this appear desirable. With the increased pressure the total tractive force, with the booster in operation, is 84,200 pounds.

We congratulate the Railway Company upon the acquisition of these fine locomotives, and naturally feel gratified that the filling of this important contract was entrusted to us.

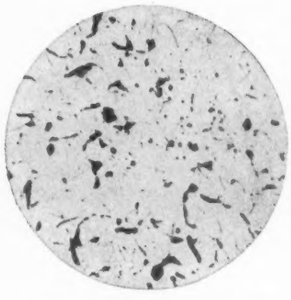
THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

ALCO NI-IRON

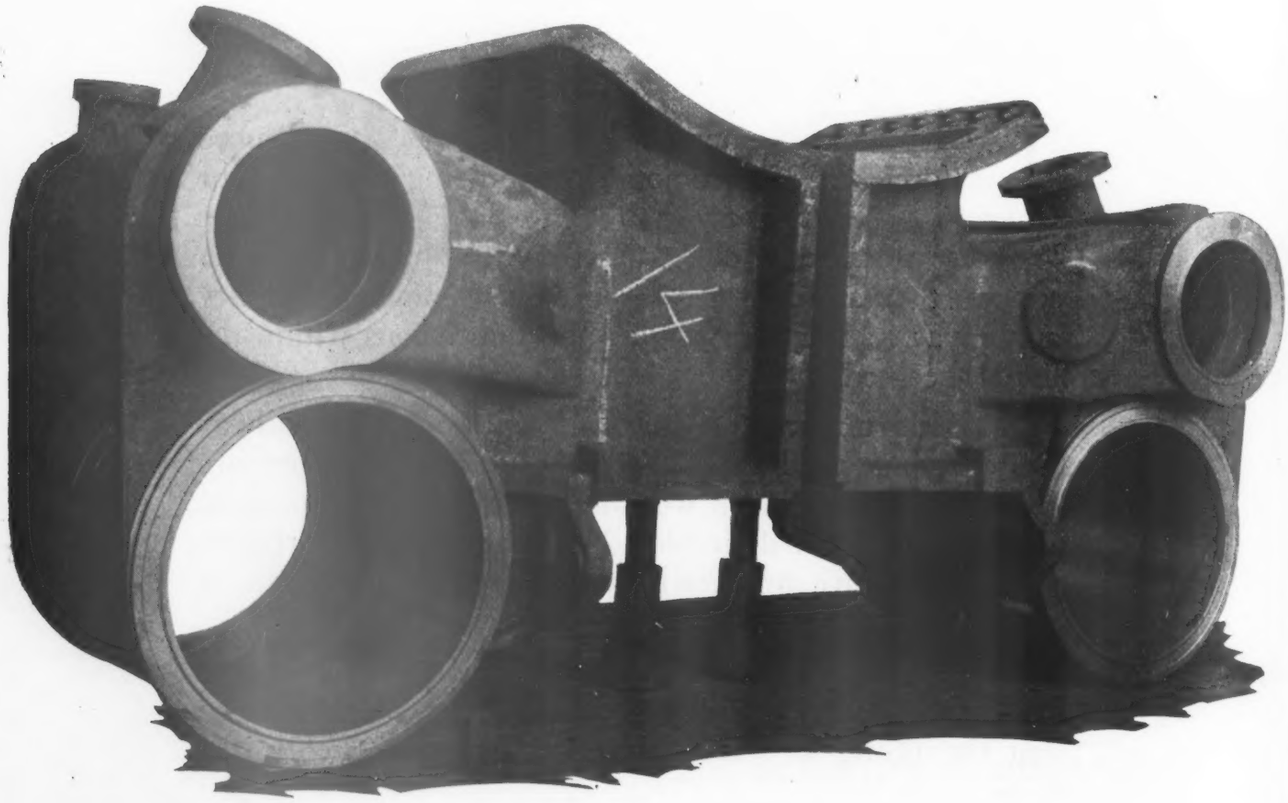
4" Test Bar from Cylinder turned to 1¼" (ALCO NI-IRON)

4" Cast Iron Test Bar turned to 1¼" diameter Regular Cylinder Iron



1¼" Standard ALCO NI-IRON Cylinder Bar

1¼" Standard Cylinder Test Bar Regular Cylinder Iron



AMERICAN LOCOMO

30 CHURCH STREET

ALCO NI-IRON

THIS iron renders a service to prevent trouble rather than to remedy it. The important thing NI-IRON does is to bring within reach of all a casting that pays back its initial cost in the repairs and renewals it saves.

NI-IRON was developed and perfected in response to a need for an iron with exceptional strength and tough enough to withstand the many conditions present day requirements have brought about. Long, hard runs with heavy trains demand extreme strength and toughness in cylinder construction. In valve and cylinder bushings there is required the ultimate in wearability as well.

NI-IRON is close grained, pressure tight and uniform. In light and heavy sections, it offers greatly increased strength and wear resistance, yet, is readily machinable and is a far more dependable iron for cylinders, valve bushings, rings, etc., than was hitherto available.

In a series of laboratory tests in a 4 in. test bar turned down to 1¼ in., an average in tensile of 28,000 developed for NI-IRON as against 15,000 for grey iron, or an increase of 87 per cent. In transverse an average of 4030 for NI-IRON as against 2380 for grey iron or an increase of 70 per cent.

NI-IRON has fully proved its definite superiority for iron cylinders and because of its wear resisting qualities, it is ideal for valve bushings, cylinder bushings and packing rings. For all parts where greater strength, toughness, higher resistance to wear, or dense material is required for pressure work, it should be specified.

Few products offer such clear cut and definite superiorities as NI-IRON. The character and prestige of NI-IRON users impart special significance to their indorsement of it.

Its cost to you is only slightly more than grey iron. Write our nearest office for complete information.

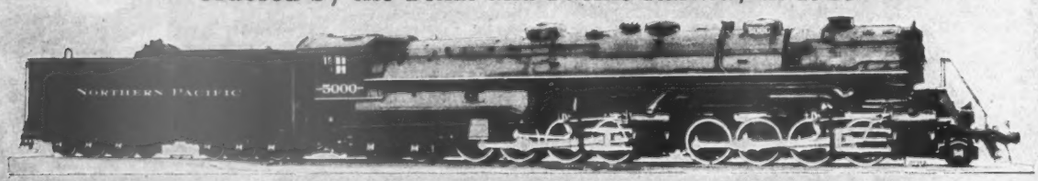
M O T I V E C O M P A N Y

NEW YORK, N. Y.

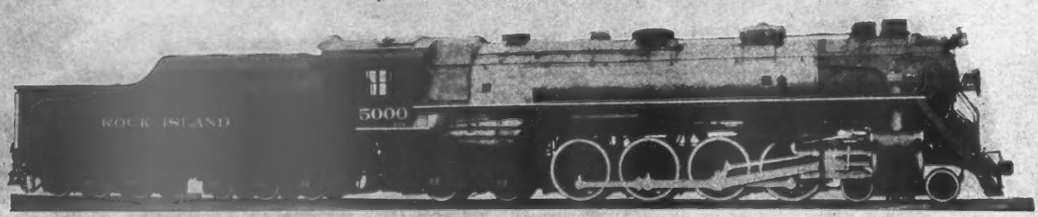
This is one of a series of advertisements showing highly efficient Syphon-Equipped locomotives for which additional orders have been placed in 1929

Repeat orders
based on outstanding performance records

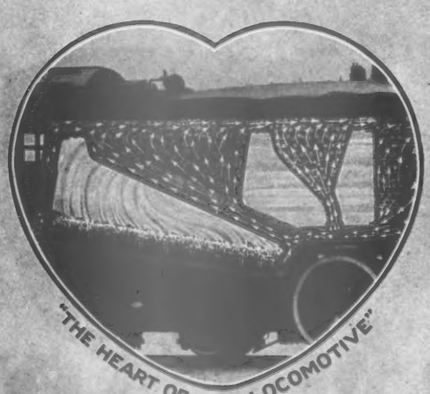
Fifteen more of these Syphon-Equipped 2-10-4 locomotives have been ordered by the Texas and Pacific Railway in 1929



Eleven more of these Syphon-Equipped Mallet Type locomotives have been ordered by the Northern Pacific in 1929



Twenty-four more of these Syphon-Equipped 4-8-4 locomotives have been ordered by the Chicago, Rock Island & Pacific in 1929



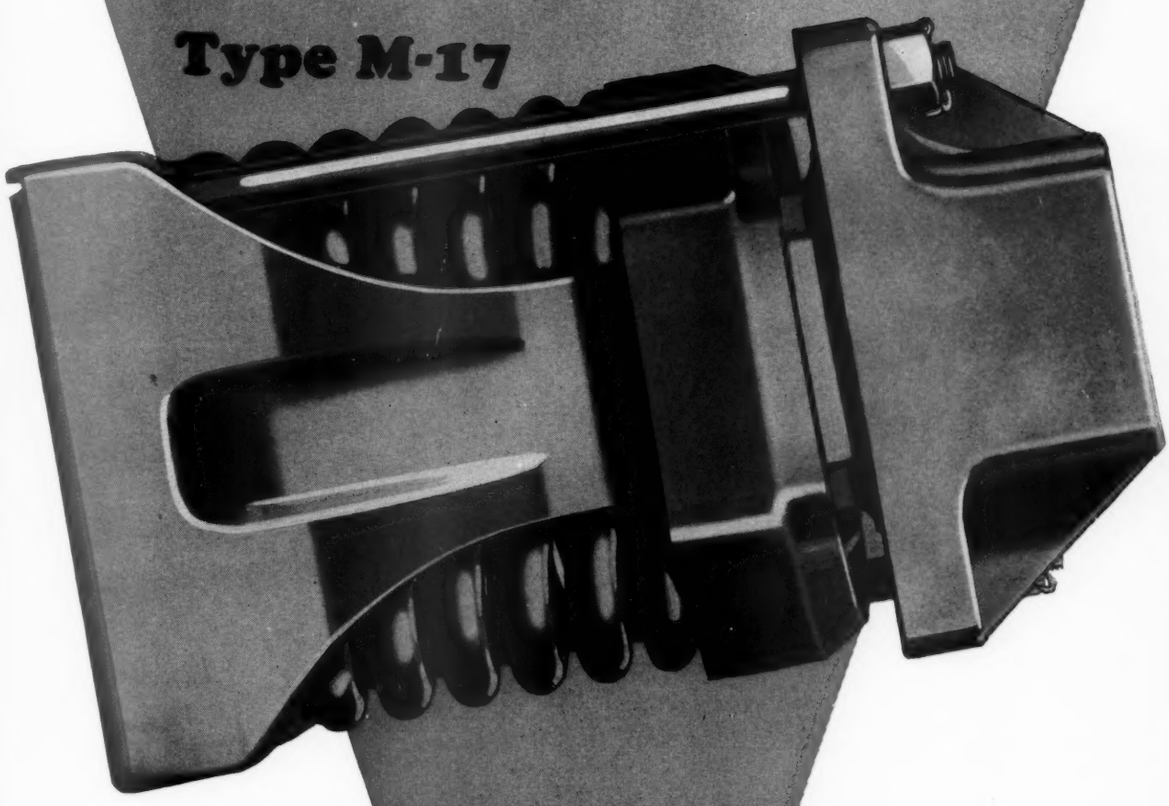
Syphon Equipped
of course

CIRCULATION
ECONOMY
SAFETY

LOCOMOTIVE FIREBOX COMPANY
MONTREAL CHICAGO NEW YORK

Reduce Maintenance Costs

Type M-17



National Malleable and Steel
Castings Company
Cleveland, Ohio

NATIONAL

ELECTRIC NACO STEEL

DRAFT GEARS

NATIONAL

M-17 Draft Gears Rank High in ALL *these important* qualities

Capacity
Sturdiness
Endurance
Smoothness
Uniformity

Proved by years of service and by laboratory tests

National Malleable and Steel
Castings Company
Cleveland, Ohio

NATIONAL

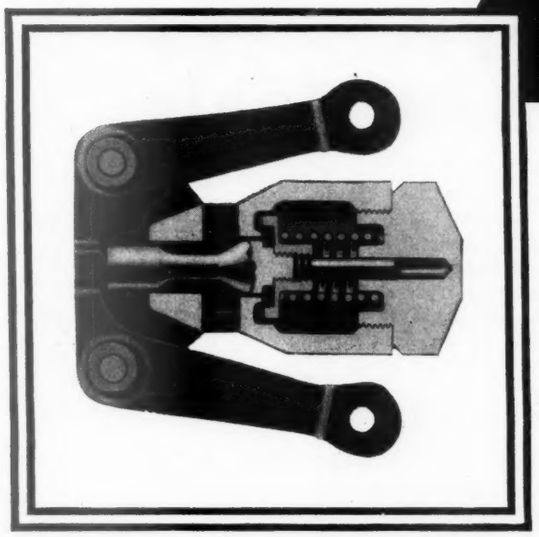
ELECTRIC NACO STEEL

DRAFT GEARS

VARIABLE RELEASE VALVE

for

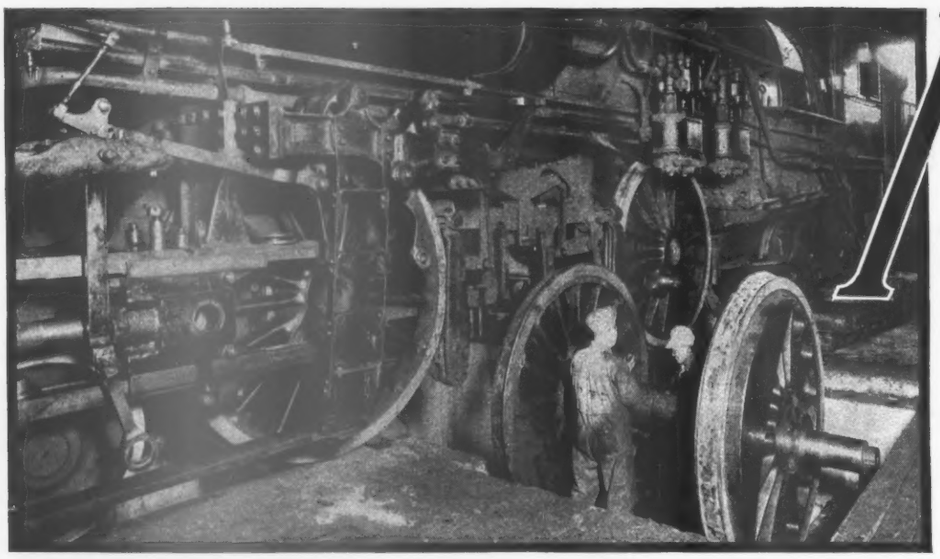
Auxiliary Reservoirs



This valve is of the horizontal type, and provides greater vertical clearance . . . its structure is rugged and substantial . . . the internal parts may be replaced, if necessary, without removing the complete device.

AN auxiliary reservoir release valve having provision for varying the rate of discharge is now available for use with freight brake equipments. . . . The travel of the variable opening vent valve determines the rate of blow down —a short pull on the hand rod results in a slow rate of air discharge—a heavy pull moves the valve to its wide open position and reduces the pressure very quickly.

WESTINGHOUSE AIR BRAKE CO.
General Office and Works, Wilmerding, Pa.



It

The safe way

Customers Praise the Whiting Drop Pit Table

"We have increased the number of wheels dropped by the Drop Pit Table by 15, in thirty days over that of the Jack."

"I have recommended for next year's budget to apply the same kind of table we now have, at our old drop pits which are not used often since we have the new table. In fact, our work has increased 200% to 300% in the dropping and changing of wheels over what it was in 1926."

"The Drop Pit Table referred to has been in service at our plant for approximately three years and during this time has rendered satisfactory and exceptionally efficient service; has not been out of service at any time and has not needed any maintenance, only that of oiling and greasing."

"Since the installation, we have performed approximately 186 various operations with an approximate saving of $2,000 over the old method."

"It ranks very high from a Safety First standpoint and takes away the dread that is usually present with the old style drop pit. We find it to be a great labor saver, requiring very little attention."

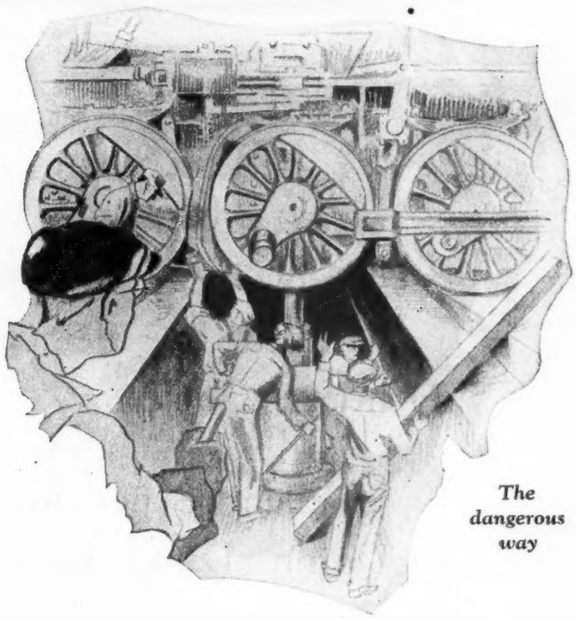
"It has been used for various purposes, such as dropping engine trucks, trailer and tender truck wheels, as well as driving wheels, and also for application of engine truck and driving springs, or spring hangers. We regard it as a labor-saving device and absolutely safe in its operation."

SPECIAL MACHINERY

We design and build special equipment and machinery of all kinds. Experienced engineers are at your service. Send us your blue prints.

WHITING

takes away the DREAD"



The dangerous way

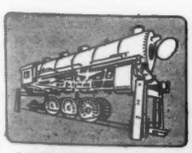
"It takes away the dread that is usually present with the old style Drop Pit", says one of our customers, and he adds, "We find it to be a great labor-saver, requiring very little attention.

We cannot compute the saving of lives and limbs in dollars and cents, but the time and labor alone saved by the Whiting Drop Pit Table in your shop will amount to thousands of dollars per year.

Send for our descriptive bulletin No. 177 and let us tell you what this table is doing for others.

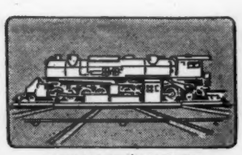
WHITING CORPORATION

15609 Lathrop Ave., Harvey, Ill. (Chicago Suburb)

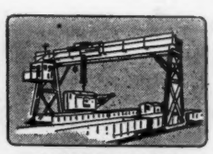


LOCOMOTIVE HOISTS

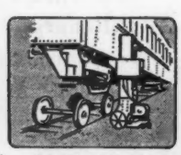
DROP TABLES



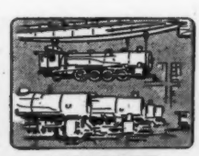
TRANSFER TABLES



GANTRY CRANES



PORTABLE CAR JACKS



LOCOMOTIVE CRANES

CARDWELL & WESTINGHOUSE
Draft Gears

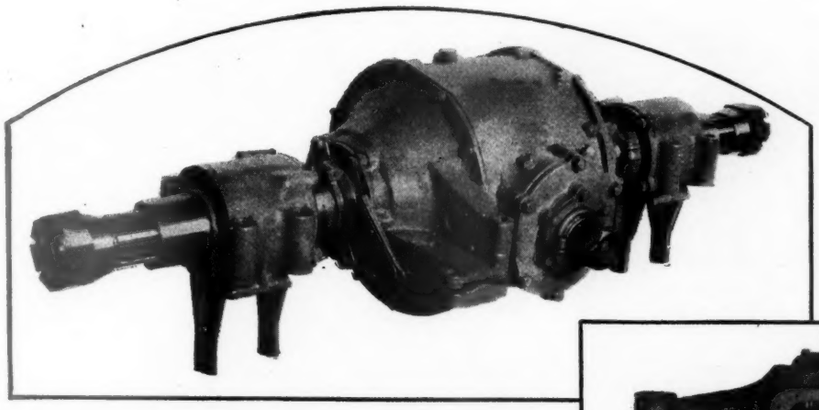
As previously announced, Westinghouse Draft Gears and Cardwell Draft Gears are now being handled by the Cardwell Westinghouse Company.

The entire personnel of the former Union Draft Gear Company continues in the same capacity with the new corporation.

Westinghouse Draft Gears will continue to be manufactured at Wilmerding, Pa., as heretofore.

CARDWELL WESTINGHOUSE CO.
332 So. Michigan Ave.,
Chicago, Illinois

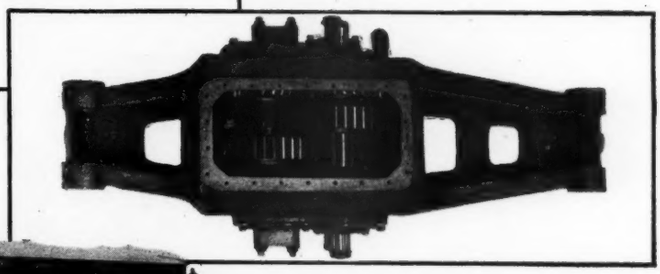
New York City, N. Y.
Pittsburgh, Pa.
St. Louis, Mo.
Montreal, Que., Can.



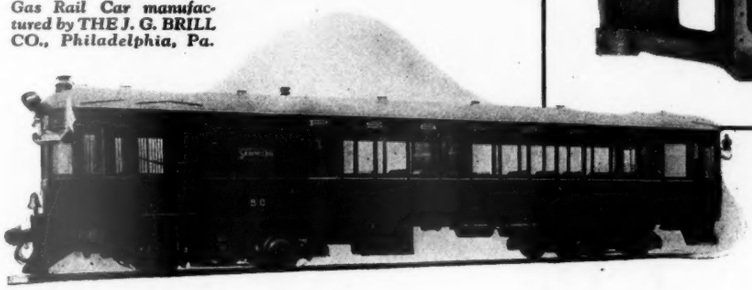
Dependable materials are the best assurance of dependable performance

LEFT: *Drive axle of model 75 car showing Nickel Alloy Steel gears and pinions.*

BELOW: *Swing bolster from drive truck showing Nickel Alloy steel transmission gears.*



BELOW: *Model 75 Brill Gas Rail Car manufactured by* THE J. G. BRILL CO., *Philadelphia, Pa.*



Brill Gas Rail Cars

use Nickel Alloy Steel for gears and pinions in transmissions and axles

IN short and branch line service the Brill gas rail car has established excellent records for low operating costs. This well known car is designed and built to withstand the severe, continuous service which requires every part to be accurately made of absolutely dependable materials.

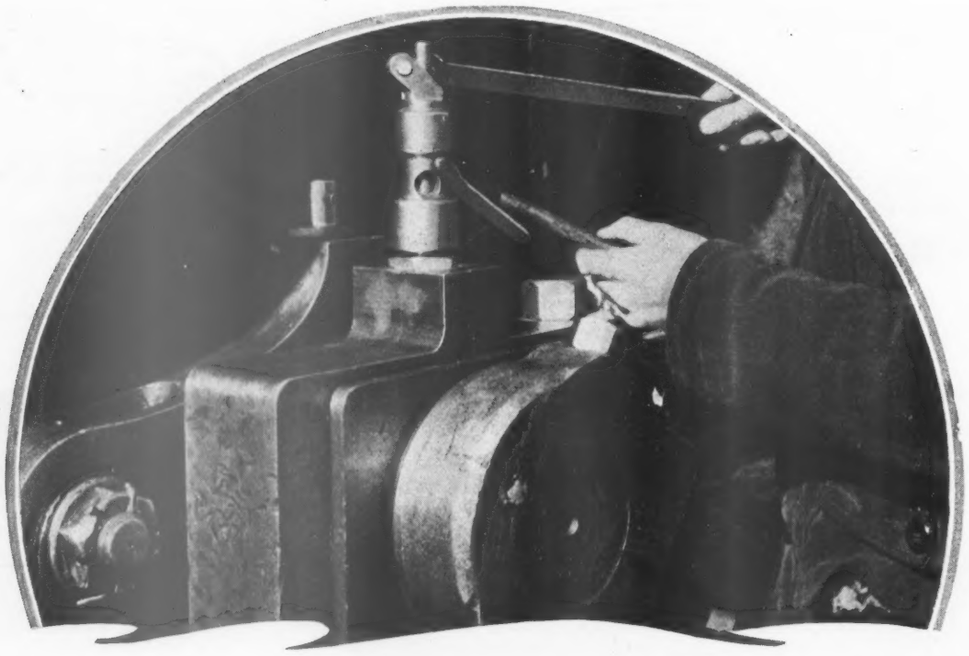
Nickel Alloy Steel parts are used in these cars for vital parts subjected to heavy shocks and stresses—the gears and pinions in the drive axles as well as in the transmissions. Here are some of the more important advantages of using Nickel Alloy Steel: (1) minimum warpage and distortion, since lower heat treating temperatures are permitted; (2) carbon penetration is more uniform during carburization; (3) greater toughness is secured in both case and core.

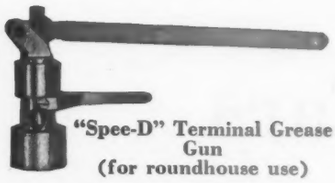
Nickel
FOR ALLOY STEEL

Probably the most impressive evidence of the uniformly dependable properties of Nickel Steel parts is the fact that practically all manufacturers of airplane engines, both in America and Europe, have adopted Nickel Alloy Steels for highly stressed parts the weight of which must be pared to a minimum.

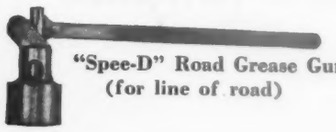
SEND FOR "BUYERS' GUIDE TO NICKEL ALLOY STEEL PRODUCTS"

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.





"Spee-D" Terminal Grease Gun
(for roundhouse use)



"Spee-D" Road Grease Gun
(for line of road)

"Spee-D" Filler Neck
(permanent rod cup fitting)

High Pressure Greasing

for

Locomotive Connecting Rod Lubrication

"SPEE-D" High Pressure GREASE GUNS

(1) Cut down labor costs materially
(2) Are simple to apply, powerful in performance
(3) Few parts, made to WEAR.

Will you become another of our satisfied users?

Write today for booklet.

RELIANCE MACHINE & STAMPING WORKS
INCORPORATED
NEW ORLEANS, LA.

Agents and Representatives

T. Z. RAILWAY EQUIPMENT COMPANY
14 E. Jackson Blvd., Chicago

H. C. MANCHESTER
3736 Grand Central Terminal, New York City

Consolidated Equipment Company, Montreal

Mumford Medland, Ltd., Winnipeg

International Railway Supply Company, 30 Church St., New York City

CLEAN BALLAST

THE USE OF
WINE DROP DOOR LOCKS
AND
CAST STEEL HOPPER FRAMES

Guarantee No Loss of Coal from the Hoppers Along the Right of Way

Peoples Gas Bldg.
Chicago

The Wine Railway Appliance Co.
TOLEDO, OHIO

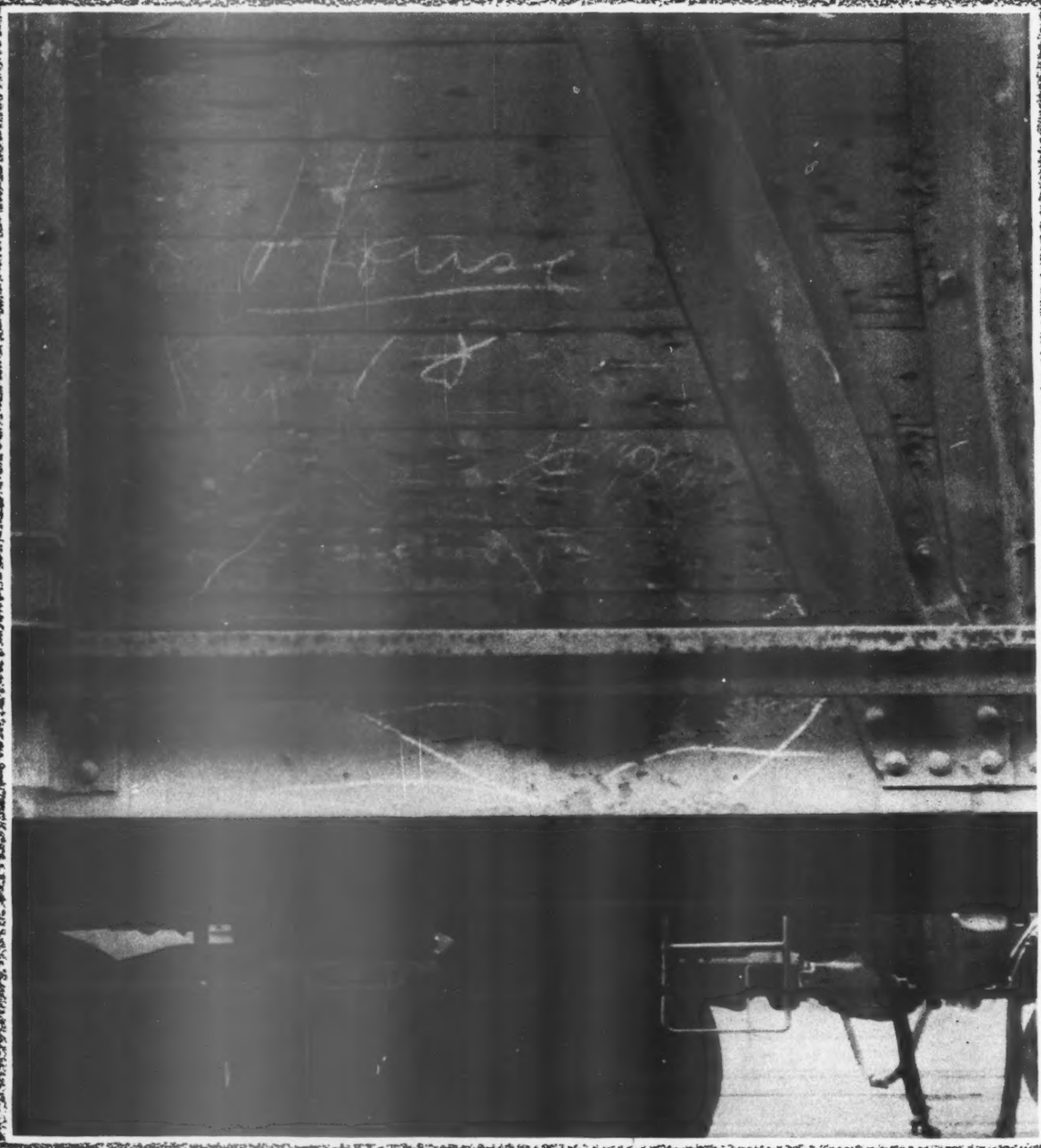
Munsey Bldg.
Washington, D. C.

The Safest and Most Economical

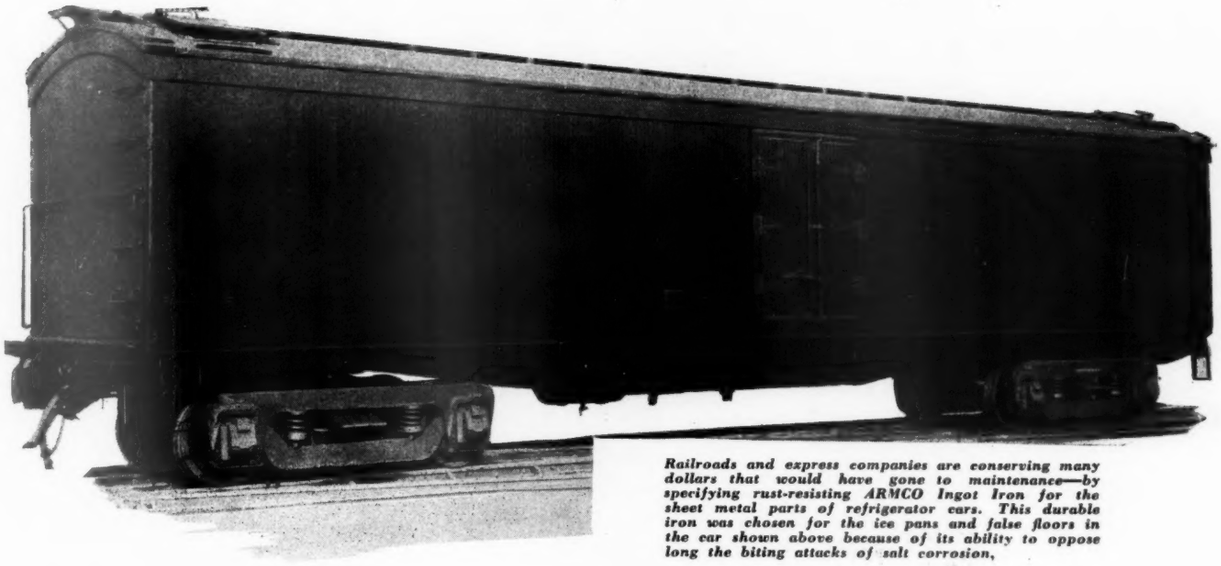
Wine DROP DOOR Locks

The Simplest of all Door Mechanisms

GET AWAY FROM PINCH BARS



USE CRECO BALL BEARING DOORS



Railroads and express companies are conserving many dollars that would have gone to maintenance—by specifying rust-resisting ARMCO Ingot Iron for the sheet metal parts of refrigerator cars. This durable iron was chosen for the ice pans and false floors in the car shown above because of its ability to oppose long the biting attacks of salt corrosion.

Give your refrigerator cars the dependable protection of ARMCO Ingot Iron

IS salt corrosion taking its costly toll from sheet metal equipment in your refrigerator cars . . . sending them back to the shop before their time?

If so, you'll welcome the long, inexpensive service which rust-resisting ARMCO Ingot Iron provides. Linings, ice pans, brine tanks, fish racks—all last long with few repairs and replacements when this durable pure iron is used.

ARMCO Ingot Iron has long been known for its ability to withstand salt corrosion. For twenty-two years it has successfully opposed this destructive invader—in refrigerator car service, in roofing and siding along the seacoast, in various marine uses; places where salt air and water soon ravage less pure irons and steels.

ARMCO Ingot Iron

Ice pans and false floors in this refrigerator car are made of galvanized ARMCO Ingot Iron—for long, low-cost service.

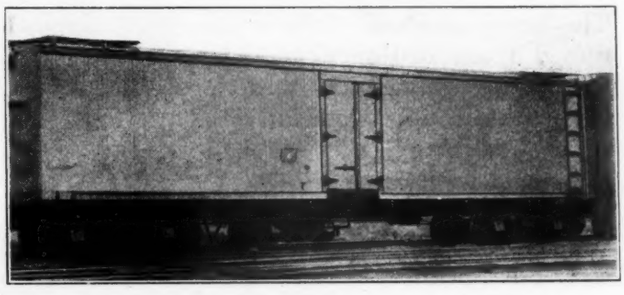
An ARMCO development engineer will be glad to work with mechanical departments in planning long-lasting, low-cost sheet metal equipment for refrigerator cars. Just communicate with the office nearest you and set the time for his call.

THE AMERICAN ROLLING MILL COMPANY

Executive Offices: Middletown, Ohio
Export: The ARMCO International Corporation
Cable Address—ARMCO, Middletown (O)

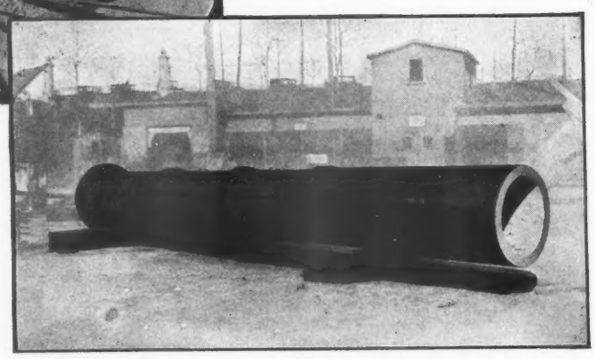
DISTRICT OFFICES:

Chicago	Detroit	Pittsburgh
Cincinnati	New York	St. Louis
Cleveland	Philadelphia	San Francisco



THE WORLD'S LARGEST EXCLUSIVE MAKERS OF SPECIAL ANALYSIS IRON AND STEEL SHEETS AND PLATES

Nickel Cast Iron cylinder liner produced by NEWPORT NEWS SHIPBUILDING & DRYDOCK CO., Newport News, Va.



Heavy stern tube casting of Nickel Cast Iron.

Maximum machinable hardness obtained in heavy *Nickel* Iron *Castings* by NEWPORT NEWS SHIPBUILDING & DRYDOCK CO.

A high degree of wear-resistance is essential in large marine engine cylinder liners. The heavy sections of these liners when produced from ordinary gray iron often lack the required hardness and density.

By the addition of a relatively small amount of "F" Nickel to a special base mixture, however, castings having a uniform density and a high, yet readily machinable hardness—197 BHN on a 4970 pound casting having sections 3″ to 4″ thick—are easily secured. The high surface finish, as shown in the illustration, indicates long life and excellent wear-resistance. Nickel Cast Iron with a tensile strength of over 40,000 p.s.i. is regularly produced by this company.

Heavy stern tube castings afford another example of how the Newport News Shipbuilding & Drydock Co. benefits from the use of Nickel Cast Iron. In these castings, also, desirable density and uniform physical properties are readily obtained.

Nickel
FOR CAST IRON

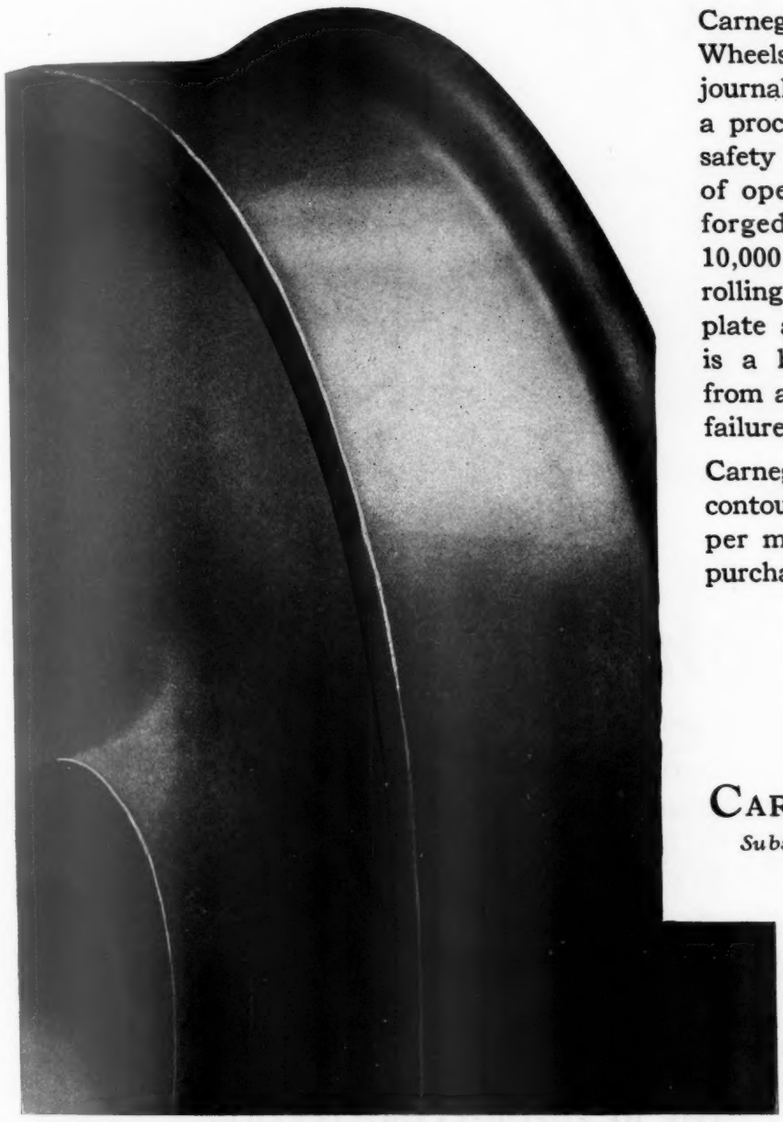
INCO F NICKEL

Our foundry specialists will gladly discuss your casting problems with you.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

ROLLED in the tread...

the lowest cost mileage available for light freight service



Carnegie Light Weight Wrought Steel Wheels for freight cars with a maximum journal of 5½"x10" are manufactured by a process insuring the greatest possible safety and service. The highest quality of open-hearth steel is hydraulically forged into a wheel under enormous 10,000 ton presses. The next step is the rolling mill where tread, flange, rim and plate are thoroughly rolled. The result is a homogeneous steel structure free from any irregularities that might cause failure.

Carnegie Light Weight Wheels require no contour reconditioning, and their low cost per mile make them the outstanding purchase in the wheel market today.

Our wheel engineers are at your service.

CARNEGIE STEEL COMPANY

Subsidiary of United States Steel Corporation

PITTSBURGH · PA. 24

CARNEGIE WROUGHT STEEL WHEELS

In the SHOP

— and on the ROAD

LOW maintenance cost and dependable performance are the two outstanding factors which influence the selection of BRADFORD THROTTLE VALVES.

The simplicity of BRADFORD design, accessibility of parts and ease of removal command the attention of every shop executive searching for ways to reduce classified repair costs.

Freedom from those annoying failures which tie up expensive power and perfect control which assures better handling of trains are the reasons why supervisors of locomotive operation prefer to have the engines under their jurisdiction equipped with BRADFORD THROTTLE VALVES.

BRADFORD
MANUFACTURERS
-of-
BRADFORD DRAFT GEARS
THROTTLE VALVES
HUNTOON TRUCK BOLSTERS
BRAKE BEAMS

THE BRADFORD CORPORATION

NEW YORK — 25 West Forty-third St.
CHICAGO — Railway Exchange

BRADFORD
Throttle Valves

Service-The Best Proof

GENERAL application of BURDEN IRON STAYBOLTS is not at all unusual after the reports on the test installations have been digested.

Comparison of failures between shopping periods and renewals during classified repairs leaves no question of doubt as to the superiority of BURDEN STAYBOLT IRON.

As for laboratory tests . . . BURDEN IRON passes every bend and nick test with flying colors. Reports never fail to comment upon its high tensile strength, unusual ductility and perfect homogeneity.

Our engineers are ready to help you in any test—static or service.

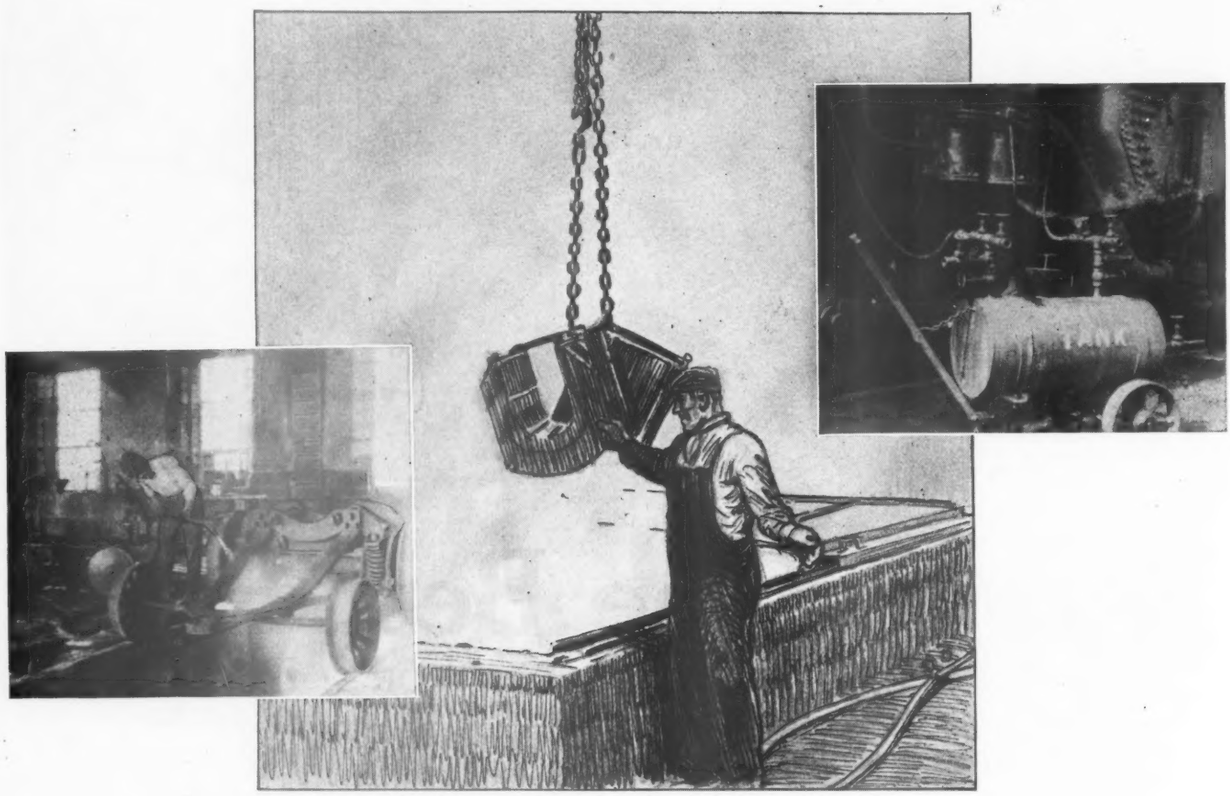
The Burden Iron Company

Troy, New York — New York, N. Y. — Chicago, Ill.

Burden Iron

Makes Better Staybolts

Cleaning methods have advanced, too!



CLEANING methods in the modern roundhouse and carshop have kept pace with modern improvements in railroad. Now carbon is removed from air pumps, without dismantling, by circulating a vaporised cleaning solution through them. Steam and air pressure cleaning is used to remove grease and grime from drivers, trucks, frames and other heavy locomotive parts. The modern cleaning tank operates effectively for long periods with small and infrequent additions for upkeep and if regularly mucked out does not require dumping for many months. Journal boxes, driving rods, cylinders, and other parts are cleaned to the metal by a short soak. Little or no scrubbing or scr aping is required.

These changes have been accomplished wherever railroads have adopted Oakite cleaning materials and methods. Find out how Oakite cleaning can effect similar improvements, save time, expense and effort in your shops, too. Our nearby Service Man will gladly explain. Just drop us a line and he will call.

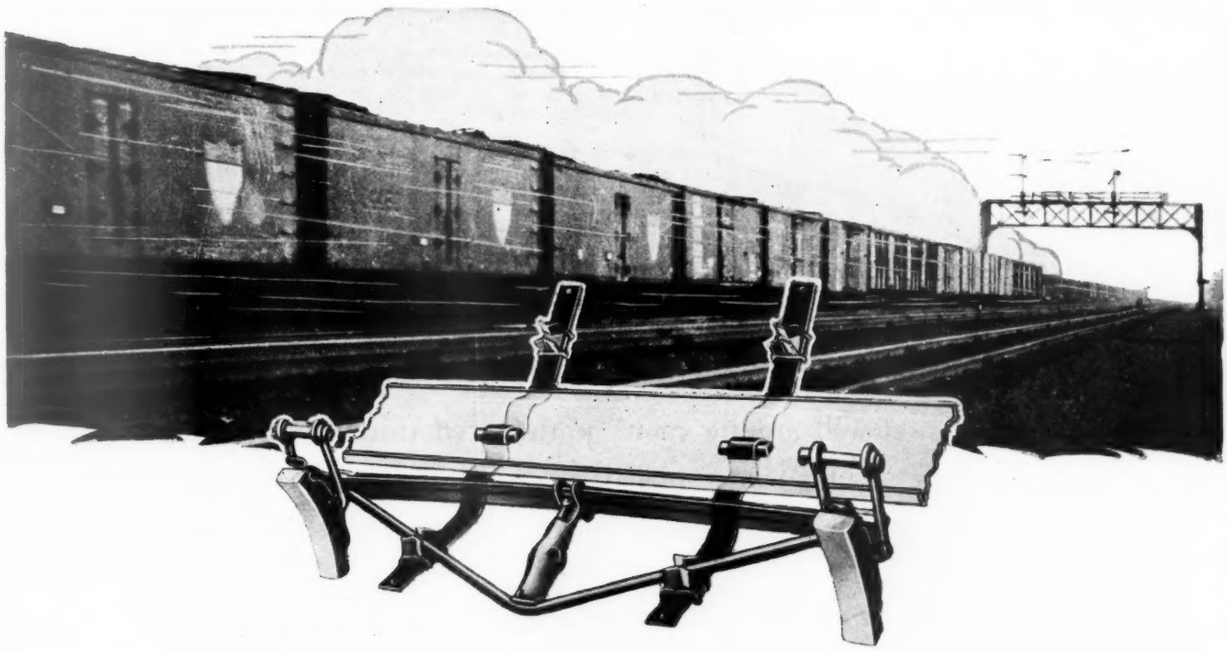
Manufactured only by
OAKITE PRODUCTS, INC., 46 Thames St., NEW YORK, N. Y.

Oakite Service Men, cleaning specialists are located conveniently near all important railroad centers of the U. S. and Canada

OAKITE

TRADE MARK REG. U.S. PAT. OFF.

Industrial Cleaning Materials and Methods



125 at 45 Per

FREIGHT trains of one hundred cars or more are now a common sight. The big, powerful locomotives of today wheel 'em over the divisions at terrific speeds.

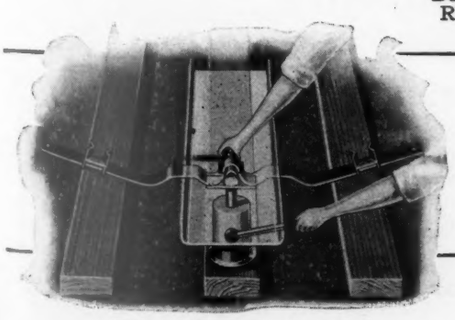
Recently a test train of 125 cars attained the speed of 45 M.P.H. A brake beam dropped in the middle of the train. No! Nothing happened—fortunately all parts cleared the rails.

The conditions of today demand serious consideration —every increase in train length and speed increases the possibility of derailment by dropped brake beams.

Why take chances when protection costs you nothing? DAVIS BRAKE BEAM SUPPORTS provide absolute safety and at the same time pay a big return on the investment by increasing the mileage of brake shoes and all brake beam wearing parts.

DAVIS SUPPORTS are easily applied and cost no more to install than the improvised safety guards.

DAVIS BRAKE BEAM CO.
JOHNSTOWN, PA.
Chicago Office: 122 South Michigan Ave.
Boston Office: 1109 Boylston Street
Richmond, Va., 1222 Mutual Bldg.



DAVIS
Brake Beam Supports

Simplest of all—Easiest to apply

The Spirit of Christmas

"Good will among men" is the predominant spirit of Christmas. This same spirit is pervading all business, not only at the Christmas season, but in all seasons of the year.

Such "good will" is based upon the growing disposition of business to place emphasis on service.

The

have always been offered the trade in the spirit of service, and in the same spirit we extend to you the heartiest greetings for the Christmas season, and wishes for a happy and prosperous New Year.

The J. B. Ford Company

Wyandotte, Michigan

LUBRICATION is probably of more general interest to industry than any other one subject. Maintenance men, and those who watch maintenance and production costs can take a leaf from the book of experience of thousands of exacting operating men by studying the results of Dixon's Flake Graphite lubrication.

For more than 100 years Dixon's Flake Graphite has been spreading its smooth unctuous veneer over contacting surfaces, reducing friction and wear to a minimum—producing dead smooth bearing surfaces that are so necessary to cool running and long life.

The results of this century of experience in handling pure Flake Graphite and the various greases compounded with graphite are yours for the asking. Send today for Booklet No. 7 KP.

JOSEPH DIXON CRUCIBLE COMPANY

Jersey City New Jersey

Established 1827

DIXON'S

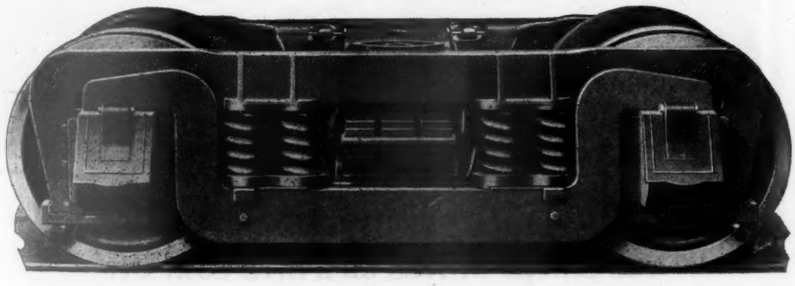
Graphite Products

Flake Graphite
Graphite Cup Grease
Waterproof Graphite Grease
Silica-Graphite Paint
Boiler Graphite
Graphite Spring Oil
Graphite Seal*
Pipe Joint Compound

*An entirely new and improved type of graphite sealing paste especially prepared for use on screw thread, flange, and gasket joints and valves of pipe lines carrying hot or cold mineral, vegetable and animal oils, gasoline, benzine, naphtha, creosote, tar, etc.

COMMONWEALTH

Four-Wheel Swing Motion Tender Truck
Drop Equalizer Type



(PATENTED)

Prevents Rolling and Avoids Derailment of Tender.

Frame Including Pedestals a Strong One-Piece Casting.

Pedestals Protected from Wear by Renewable Hardened Steel Liners.

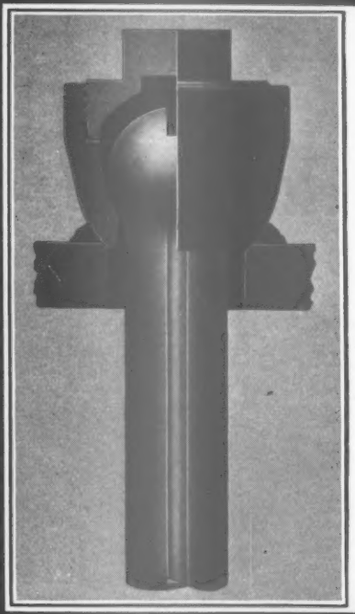
Commonwealth Devices are Standard on Many Railroads.

GENERAL STEEL CASTINGS CORPORATION

Commonwealth Division Granite City, Illinois

FLANNERY FLEXIBLE STAYBOLTS

FLEXIBLE STAYBOLTS



When buying staybolts, look beyond "price" as the factor governing your selection.

Just as truly as installation costs are lowered through the purchase of "cheaper" staybolts, so the safety, efficiency, and life, of a firebox is lowered.

Are the stays you are using *just* bars of iron—merely shaped at one end for use as flexibles? Aren't they *expensive* by reason of their short lived usefulness?

Turn to Flannery Flexibles to gain freedom from maintenance worries. Insist upon the staybolt which is subjected to an additional finishing process,—to guarantee its flexibility,—restore the granular structure of the iron in its head (perhaps injured through forging),—and increase the tensile strength of the head and neck of the bolt.

Remember—first installation costs should not dictate the make of flexible staybolts you use—it's the year in and year out maintenance that should be the sole consideration.

With this in mind, you will be certain to choose Flannery Flexibles.

FLEXIBLE STAYBOLTS

FLANNERY FLEXIBLE STAYBOLTS

FLANNERY BOLT COMPANY

Flannery Bldg. Pittsburgh, Pa.

APPLY MEXICAN GRAPHITE NO. 205 When *you* Make Triple Valve Repairs

FOR after repairs are made the Mexican Graphite will prolong their service period and reduce future maintenance by reducing frictional wear. It provides a smooth slippery coating between tightest piston fits and enables triple valves to function accurately assuring consistent and dependable brake action.

This lubricant is composed of amorphous graphite which works into the metal. It will not congeal in cold weather or run out in hot weather.

THE UNITED STATES GRAPHITE COMPANY
SAGINAW, MICHIGAN

Philadelphia New York Chicago Pittsburgh St. Louis

Mexican Graphite Products

Smooth Irregular Surfaces—Reduce Friction Wear

Buying the Seen and the Unseen

It is easy to judge the size and quality of a visible commodity. There are certain recognized standards that have been universally accepted to which purchased articles may be compared.

With invisible commodities, such as a publication's circulation, the matter is not so simple. It was only recently that a definite measurement has been obtained.

The A. B. C. now furnishes a recognized standard by which circulation may be measured. A publication's distribution can now be as accurately gauged as any other purchased commodity.

The *Railway Mechanical Engineer's* circulation is measured by the A. B. C. In buying advertising space in its columns, you receive dollar-for-dollar value.

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Tell Us What Size You Want

The two bronze-to-bronze seats, ground together, make an accurate fit and eliminate all possibility of corrosion. Extra heavy malleable pipe ends surmounted by a heavy swivel tightening nut, make the Dart Union a single, unleaking unit. We'll be glad to send you a Dart Union FREE. Tell us what size you want.

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The Fairbanks Co., Sales Agents
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Superheaters
Feed Water Heaters
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The value of these devices is measured by the difference in the cost of operating locomotives with them and without them.

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For detailed description see Locomotive Cyclopedia

BUYERS INDEX

For location of advertisements of manufacturers listed in the Buyers Index, see Alphabetical Index on the last page next to cover

Accumulators, Hydraulic
Chambersburg Engineering Co.
General Machinery Corp. of Delaware.
United Engineering & Foundry Co.
Watson-Stillman Co., The.
Wood & Co., R. D.

Acetylene, Gas
Milburn Co., The Alexander.

Acetylene Welding Rods and Wire — (See Welding Rods and Wire).

Air Compressors—See Compressors, Air).

Air Drills—(See Drilling Machines, Portable Pneumatic).

Air Hammers—(See Hammers, Pneumatic).

Air Hoists—(See Hoists, Air)

Air Hose—(See Hose, Air).

Air Lifts.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Air Pump Cleaners
Oakite Products, Inc.

Air Reservoir Joints — (See Joints, Air Reservoir).

Arbors and Mandrels, Solid.
Brown & Sharpe Mfg. Co.
Ingersoll Milling Machine Co., The.
McCrosky Tool Corp.

Arch Tube Cleaners — (See Tube Cleaners).

Arch Tubes.
National Tube Co.

Arrestors, Electric.
General Electric Co.

Ash Pans, Cast Steel.
General Steel Castings Corp.

Automatic Chucking and Turning Machines—(See Lathes, Automatic Chucking and Turning).

Automatic Connectors—(See Connectors, Automatic).

Automatic Milling Machines —(See Milling Machines, Automatic).

Automatic Screw Drivers — (See Screw Drivers, Automatic).

Automatic Screw Machines—(See Screw Machines, Automatic).

Axles, Car and Locomotive.
Bethlehem Steel Co.
Carnegie Steel Co.
Lima Locomotive Works.

Banding Presses, Hydraulic—(See Presses, Banding).

Barrels, Tumbling.
Whiting Corporation.

Bars, Boring — (See Boring Bars).

Bars, Concrete, Reinforcing.
Carnegie Steel Co.

Bars, Iron and Steel.
Burden Iron Co.
Carnegie Steel Co.
Highland Iron & Steel Co.
Reading Iron Co.
S. K. F. Industries.
Timken Roller Bearings Co.

Beading Machines
Quickwork Co., The.

Beading Tools.
Carpenter Steel Co., The.

Bearings, Axle, Generator.
S. K. F. Industries
Timken Roller Bearing Co.

Bearings, Ball.
S. K. F. Industries

Bearings, Ball Thrust
S. K. F. Industries

Bearings, Car.
American Steel Foundries.

Bearings, Center
American Steel Foundries.
Chicago Ry. Equipment Co.
National Malleable and Steel Castings Co.
S. K. F. Industries

Bearings, Roller.
S. K. F. Industries.
Timken Roller Bearing Co.

Bearings, Side
American Steel Foundries.
Chicago Ry. Equipment Co.
O. & C. Co., The.
Wine Railway Appliance Co.

Bearings, Tapered Roller
Timken Roller Bearing Co.

Beds, Cast Steel, Electric.
General Steel Castings Co.

Bearings, Thrust
S. K. F. Industries.
Timken Roller Bearing Co.

Beds, Cast Steel, Electric.
General Steel Castings Co.

Belt Dressing.
Dixon Crucible Co., Jos.

Belt Headers.
National Machinery Co. The.

Bench Legs.
Brown & Sharpe Mfg. Co.

Bending and Forming Machines.
Quickwork Co., The.

Bending Machines, Hand and Power.
Buffalo Forge Co.
Cleveland Punch & Shear Works Co.
General Machinery Corp. of Delaware.
Hilles & Jones Works of the Consolidated Mach. Tool Corp. of America.
Pels & Co., Henry.
Sellers & Co., Inc., Wm.
Underwood Corp., H. B.
Watson-Stillman Co., The.

Bending Machines, Hydraulic.
Chambersburg Engineering Co.
General Machinery Corp. of Delaware.
Watson-Stillman Co., The

Bending Rolls — (See Rolls, Bending and Straightening).

Billets, Steel.
Carnegie Steel Co.

Bits, Machine Tool — (See Tool Holder Bits—High Speed Steel).

Bits, Track and Bonding—(See Drills, Track and Bonding).

Blocks, Chain — (See Hoists, Chain).

Blooms, Steel.
Carnegie Steel Co.

Blower Fitting Automatic Smoke Box.
Barco Mfg. Co.

Blowers
Buffalo Forge Co.

Blowpipes
Milburn Co., The Alexander.

Boiler Chemicals.
Dearborn Chemical Co.

Boiler Compounds — (See Compounds, Boiler.)

Boiler Mountings
Lunkenheimer Co.

Boiler Tubes, Charcoal Iron.
Reading Iron Co.

Boiler, Tube Cleaners—See Tube Cleaners).

Boilers, Locomotive.
American Locomotive Co.
Baldwin Locomotive Works The.
Bradford Corp., The
Commonwealth Steel Co.

Bolsters, Car.
American Steel Foundries.

Bolsters, Steel.
American Steel Foundries.
Bradford Corp., The.
General Steel Castings Corp.

Bolt Cutters — (See Thread Cutting Machines, Bolt).

Bolt Iron, Engine
Burden Iron Co.

Bolt Pointers.
National Machinery Co., The

Bolt and Nut Machinery.
Acme Machinery Co., The
Ajax Manufacturing Co.
General Machinery Corp. of Delaware.
Landis Machine Co., Inc.
National Mchy. Co., The
Williams Tool Corp.

Bolt and Rod Threaders
National Machinery Co., The.

Bolts & Nuts.
Bethlehem Steel Co.

Bonding Outfits, Rail.
Ingersoll-Rand Co.

Books—Railway.
Simmons-Boardman Pub Co.

Boosters.
Franklin Ry. Supply Co.

Boring Bars.
Davis Boring Tool Co.
Gidding & Lewis Mach. Tool Co.
Ingersoll Milling Machine Co., The.

Boring Bars, Expansion.
Davis Boring Tool Co.

Boring Bars, Locomotive Cylinder —(See Boring Machines, Portable).

Boring and Drilling Machines Horizontal.
Betts Works of Consolidated Mach. Tool Corp of America.
General Machinery Corp. of Delaware.
Gidding & Lewis Mach. Tool Co.
Ingersoll Milling Machine Co., The
Lucas Machine Tool Co.
Sellers & Co., Inc., Wm.

Boring and Drilling Machines, Vertical.
Betts Works of Consolidated Mach. Tool Corp. of America.
Colburn Mach. Tool Works of Consolidated Mach. Tool Corp. of America.
General Machinery Corp. of Delaware.
Ingersoll Milling Machine Co., The.
Sellers & Co., Inc., Wm.

Boring and Turning Mills, Vertical.
Betts Works of Consolidated Machine Tool Corp. of America.
Bullard Co., The.
Colburn Machine Tool Plant of Consolidated Machine Tool Corp. of America.
General Machinery Corp. of Delaware.
Manning, Maxwell & Moore, Inc.
Sellers & Co., Wm.

Boring Machines, Car Wheel.
Betts Works of Consolidated Mach. Tool Corp. of America.
General Machinery Corp. of Delaware.
Ingersoll Milling Machine Co., The.
Manning, Maxwell & Moore, Inc.
Sellers & Co., Inc., Wm.

Boring Machines, Cylinder
Betts Works of Consolidated Mach. Tool Corp of America.
General Machinery Corp. of Delaware
Newton Works of Consolidated Mach. Tool Corp. of America.
Sellers & Co., Inc., Wm.

Boring Machines, Portable, (for Loco. Cylinder and Valve Chambers).
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Rooksby, E. J. & Co.
Underwood Corp., H. B.

Boring Machines, Wood Boring
General Machinery Corp. of Delaware.
Ingersoll Milling Mach. Co.
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Boring Machines, Locomotive Driving Box.
Sellers & Co., Inc., Wm.

Boring Machines, Tire.
Betts Works of Consolidated Machine Tool Corp. of America.
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Boring Machines, Traveling Heads.
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Boring Tools (see Tools, Boring).

Braces, Rail.
National Malleable & Steel Castings Co.

Brake Beams.
American Steel Foundries.
Bradford Corp., The.
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Brake Beam Supports.
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Westinghouse Air Brake Co.

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Chicago Ry. Equipment Co.

Brake Wheels.
National Malleable and Steel Castings Co.

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Westinghouse Air Brake Co.

Brakes, Electric
Westinghouse Air Brake Co.

Brakes, Hand.
National Malleable & Steel Castings Co.
Wine Railway Appliance Co.

Brakes, Press.
Wine Railway Appliance Co.

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Milburn Co., The Alexander.

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Dixon Crucible Co., Jos.
U. S. Graphite Co.
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Hunt & Son, C. B.
Standard Elextrical Tool Co., The.

Buffers, Friction.
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Ajax Manufacturing Co.
General Machinery Corp. of Delaware.
National Machinery Co., Watson-Stillman Co.

Burring Machines.
Acme Machinery Co., The
Ajax Mfg. Co.
National Machinery Co.

Bushing Presses, Hydraulic—(See Presses, Bushing).

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General Electric Co.

Calipers, Bow.
Brown & Sharpe Mfg. Co.
Starrett Co., The. L. S.

Calipers, Micrometer.
Starrett Co., The L. S.

Car Door Fixtures.
Chicago Railway Equipment Co.
National Malleable and Steel Castings Co.
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Bethlehem Steel Co.

Cars, Industrial.
Bethlehem Steel Co.

Cars, Motor.
General Electric Co.

Cars, Tank.
Bethlehem Steel Co.

Cast Iron Welding Rods—(See Welding Rods).

Cast Steel Welding Rods—(See Welding Rods).

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General Steel Castings Corp.

Castings, Grey Iron.
Chambersburg Engineering Co.

Castings, Hylastic.
American Steel Foundries.

Castings, Iron.
American Steel Foundries.
General Steel Castings Corp.
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International Nickel Co.

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American Steel Foundries.
Bethlehem Steel Co.
General Steel Castings Corp.
Lunkenheimer Co., The
National Malleable & Steel Casting Co.

Cement, Iron.
Smooth-On Mfg. Co.

Center Bearings—(See Bearings Center).

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Starrett Co., The. L. S.

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Clamps, Machinists'.
Starrett Co., The L. S.

Clamps, Pipe.
National Malleable & Steel Castings Co.

Cleaner, Metal—(See Compounds, Cleaning).

Clippers, Bolt
Porter, Inc., H. K.

Coach and Coach Yard Steam Joints — (See Joints, Coach Yard).

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General Machinery Corp. of Delaware.

Cocks
Lunkenheimer Co.

Collets.
Brown & Sharpe Mfg. Co.
Geometric Tool Co., The.

Combination Boiler Checks—(See Boiler Checks).

Compounds, Boiler.
Bird-Archer Co., The.
Dearborn Chemical Co.

Compounds, Cleaning.
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Rooksby & Co., E. J.
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Cupolas, Foundry.
Whiting Corporation.

Cutters, Bolt—(See Thread Cutting Machines, Bolt).

Cutters, Chain
Porter, Inc., H. K.

Cutters, Gear.
Brown & Sharpe Mfg. Co.
National Tool Co., The.

Cutters, Milling—(See Milling Cutters)

Cutters, Pipe.
Landis Machine Co.

Cutters, Rivet.
Carpenter Steel Co., The.
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Cutters, Sprue.
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Cutters, Wire
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Landis Machine Co.

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Chicago Railway Equipment Co.

Doors, Locomotive Fire Box
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American Steel Foundries.
Bradford Corp., The

Draft Gear Yokes
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Draft Gears
Bradford Corp., The.
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Colburn Mach. Tool Works of Consolidated Machine Tool Corp. of America.
General Machinery Corp. of Delaware.
Ingersoll Milling Machine Co., The
Sellers & Co., Inc., Wm.

Drilling Machines, Horizontal—(See Boring and Drilling Machines, Horizontal)

Drilling Machines, Multiple Spindle.
Colburn Mach. Tool Works of Consolidated Machine Tool Corp. of America.
Ingersoll Milling Machine Co., The.

Drilling Machines, Portable, Electric.
Independent Pneumatic Tool Co.

Drilling Machines, Portable, Pneumatic.
Buckeye Portable Tool Co.
Cleveland Pneumatic Tool Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.

Drilling Machines, Radial.
Buffalo Forge Co.
Gidding & Lewis Mach. Tool Co.
Manning, Maxwell & Moore, Inc.

Drilling Machines, Rail.
Colburn Mach. Tool Works of Consolidated Machine Tool Corp. of America.
Ingersoll Milling Machine Co., The.
General Machinery Corp. of Delaware.
Newton Works of Consolidated Machine Tool Corp. of America.
Sellers & Co., Inc., Wm.

Drilling Machines, Rock.
Ingersoll-Rand Co.
Sullivan Machinery Co.

Drilling Machines, Universal.
Gidding & Lewis Mach. Tool Co.

Drilling Machines, Vertical.
Buffalo Forge Co.
Colburn Mach. Tool Works of Consolidated Machine Tool Corp. of America.
General Machinery Corp. of Delaware.
Ingersoll Milling Machine Co., The.
Sellers & Co., Inc., Wm.

Drills.
Brubaker & Bro., W. L.
Buckeye Portable Tool Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
Standard Electrical Tool Co.

Drills, Close Corner.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.

Drills, Core.
Ingersoll-Rand Co

Drills, Pneumatic.
Buckeye Portable Tool Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.

Drills, Portable Electric.
Standard Electrical Tool Co., The.

Drills, Rock.
Ingersoll-Rand Co.

Drills, Track and Bonding.
Bird-Archer Co., The.
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.

Driving Boxes, Locomotive.
Franklin Ry. Supply Co.

Driving Wheel Centers—(See Wheel Centers, Driving).

Drop Forgings—(See Forgings, Drop).

Drop Forgings Pliers
McKaig Hatch, Inc.

Drop Hammers, Board Drop—(See Hammers, Drop).

Drop Pit Table, Electric.
Whiting Corporation.

Drop Testing Machines.
Whiting Corporation.

Dynamos — (See Generators, Electric).

Electric Rivet Heaters—(See Rivet Heaters, Electric).

Electric Supplies.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Electric Welders—(See Welding Machines, Electric).

Electric Welding Rods and Wire — (See Welding Rods).

Engine Bolt Iron.
Wrought Iron Research Ass'n.

Engine Lathes—(See Lathes, Engine).

Engines, Corliss.
United Eng. & Fdry. Co.

Engines, Crude and Fuel Oil.
Worthington Pump & Machinery Corp.

Engines, Diesel Oil.
Worthington Pump & Machinery Corp.

Engines, Gas and Gasoline.
Ingersoll-Rand Co.
United Eng. & Fdry. Co.
Worthington Pump & Machinery Corp.

Engines, Steam.
Buffalo Forge Co.

Expanding Mandrels — (See Arbors and Mandrel Expanding).

Expanders, Tube.
Watson-Stillman Co., The.

Fans, Electric.
Buffalo Forge Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Fans, Ventilating.
Buffalo Forge Co.
General Electric Co.

Fasteners, Car Door.
National Malleable & Steel Castings Co.

Feedwater Heaters, Locomotive.
Superheater Co., The.
Worthington Pump & Machinery Corp.

Feedwater Heaters, Stationary.
Worthington Pump & Machinery Corp.

Fencing, Iron.
Page Steel & Wire Co.

Fencing, Wire.
Page Steel & Wire Co.

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Firebox Paint, Dry.
U. S. Graphite Co.

Fireboxes.
Locomotive Firebox Co.

Fittings, Air Brake.
Westinghouse Air Brake Co.

Fittings, Brass.
Lunkenheimer Co.

Fittings, Gas Fixtures.
Dart Mfg. Co., E. M.

Fittings, Hydraulic.
Chambersburg Engineering Co.
Watson-Stillman Co., The.

Fixtures, Car Door.
National Malleable & Steel Castings Co.

Flanges, Pipe.
Dart Mfg. Co., E. M.

Flanges, Snow and Ice.
Q. & C. Co., The.

Flanging Clamps — (See Clamps, Flanging).

Flanging Presses — (See Presses, Flanging).

Flue Cutters—(See Cutters, Flue).

Flue Rattlers.
Draper Manufacturing Co.

Flue Welders (see Welders, Flue).

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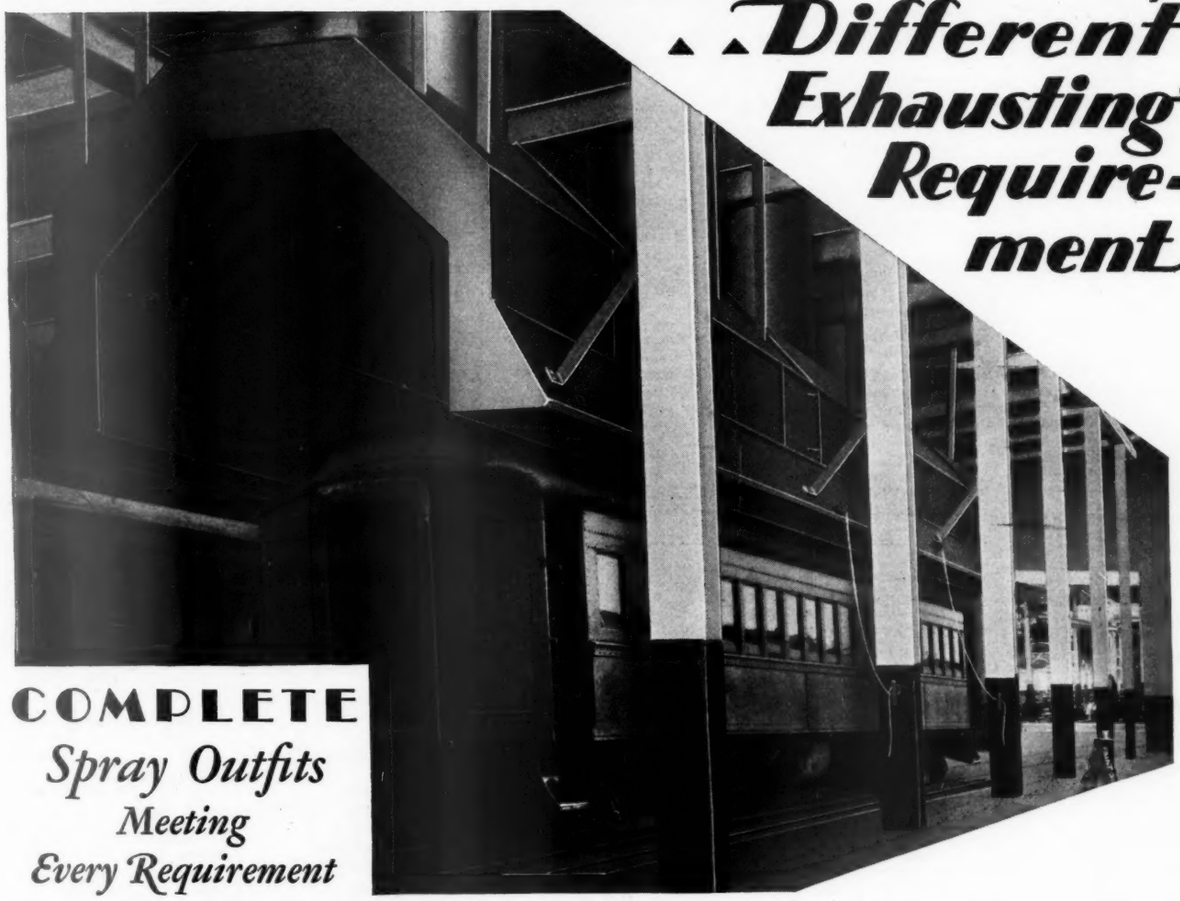

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Lunkenheimer Co.

Gages, Dial.
Brown & Sharpe Mfg. Co.
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Lunkenheimer Co.

Gages, Plug.
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Ashton Valve Co.
Watson-Stillman Co., The

Gages, Recording.
General Electric Co.

Gages, Ring.
Brown & Sharpe Mfg. Co.

Gages, Snap.
Brown & Sharpe Mfg. Co.

Gages, Steam.
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Gages, Tool.
Brown & Sharpe Mfg. Co.

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Milburn Co., The Alexander.

Gages, Wheel Press Recording.
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Garlock Packing Co., The.
Westinghouse Air Brake Co.

Gate Shears—(See Shears, Gate).

Gear Cutting Machine.
Brown & Sharpe Mfg. Co.

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National Tool Co., The.

Gears, Cut.
General Electric Co.
United Eng. & Fdry. Co.
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General Electric Co.

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Oxweld Railroad Service Co., The.

Generators, Electric.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Gloves & Goggles, Welding
Milburn Co., The Alexander.

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Dixon Crucible Co., Jos.
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Franklin Ry. Supply Co.

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Lunkenheimer Co.

Grease Guns, High Pressure
Reliance Machine & Stamping Wks., Inc.

Greases.
Dixon Crucible Co., Jos.
U. S. Graphite Co.

Grinders, Crank Pin, Portable.
Micro Machine Co.

Grinders, Cylinder.
Hutto Engineering Co.

Grinders, Rod, Portable Pneu
Independent Pneumatic Tool Co.

Grinding Machines, Bench Type.
Standard Electrical Tool Co.

Grinding Machines, Chucking.
Heald Machine Co.
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Grinding Machines, Cutter and Reamer.
Brown & Sharpe Mfg. Co.
Ingersoll Milling Machine Co.
Landis Tool Co.
Thompson Grinder Co., The.

Grinding Machines, Cylindrical.
Brown & Sharpe Mfg. Co.
Heald Machine Co.
Landis Tool Co.
Modern Tool Works of Consolidated Machine Tool Corp. of America.
Thompson Grinder Co., The.

Grinding Machines, Die.
Acme Machinery Co., The
Geometric Tool Co., The.
Modern Tool Works of Consolidated Machine Tool Corp. of America.
National Machinery Co.

Grinding Machines, Drill.
Sellers & Co., Inc., Wm.

Grinding Machines, Edge.
Thompson Grinder Co., The.

Grinding Machines, Electric.
Standard Electrical Tool Co.

Grinding Machines, Floor Type.
Landis Tool Co.
Modern Tool Works of Consolidated Machine Tool Corp. of America.
Standard Electrical Tool Co.

Grinding Machines, Gap.
Landis Tool Co.

Grinding Machines, Internal.
Heald Machine Co.
Landis Tool Co.
Micro Machine Co.
Modern Tool Works of Consolidated Machine Tool Corp. of America.
Standard Electrical Tool Co.
Thompson Grinder Co., The.

Grinding Machines, Locomotive Frame, Portable Pneumatic.
Buckeye Portable Tool Co.

Grinding Machines, Portable, Electric.
Cleveland Pneumatic Tool Co.
Independent Pneumatic Tool Co.
General Electric Co.
Standard Electrical Tool Co.

Grinding Machines, Portable, Pneumatic.
Buckeye Portable Tool Co.
Independent Pneumatic tool Co.
Ingersoll-Rand Co.

Grinding Machines, Surface, Horizontal Spindle.
Thompson Grinder Co., The.

Grinding Machines, Surface.
Brown & Sharpe Mfg. Co.

Grinding Machines, Surface Rotary Table.
Heald Machine Co.

Grinding Machines, Tool.
Brown & Sharpe Mfg. Co.

Grinding Machines, Universal.
Brown & Sharpe Mfg. Co.
Modern Tool Works of Consolidated Machine Tool Corp. of America.
Thompson Grinder Co., The.

Grinding Machines, Universal Tool.
Landis Tool Co.
Sellers & Co., Inc., Wm.

Grinding and Polishing Machines.
Modern Tool Works of the Consolidated Mach. Tool Corp. of America.
Standard Electrical Tool Co.

Ground Rods.
Page Steel & Wire Co.

Guard Rails—(See Rails, Guard).

Guards, Machine.
Page Steel & Wire Co.

Hack Saw Machines, Power—(See Sawing Machines, Power Hack).

Hack Saws — (See Saws, Hack).

Hammers, Air.
Ingersoll-Rand Co.

Hammers, Ball Pin
McKaig Hatch, Inc.

Hammers, Belt and Motor Driven.
Chambersburg Engineering Co.

Hammers, Board Drop.
Chambersburg Engineering Co.

Hammers, Drop.
Chambersburg Engineering Co.
Niles-Bement-Pond Co.
United Eng. & Fdry. Co.

Hammers, Forging.
Chambersburg Engineering Co.

Hammers, Pneumatic.
Cleveland Pneumatic Tool Co.
Ingersoll-Rand Co.

Hammers, Pneumatic Forging.
Chambersburg Engineering Co.
General Machinery Corp. of Delaware.
Independent Pneumatic Tool Co.
Sullivan Machinery Co.

Hammers, Power, Belt and Motor Driven.
Quickwork Co., The

Hammers, Riveting
Independent Pneumatic Tool Co.
Ingersoll Rand Co.

Hammers, Sheet Metal.
Quickwork Co., The.

Hammers, Steam.
Sellers & Co., Inc., Wm.

Hammers, Steam Forging.
General Machinery Corp. of Delaware.

Hammers, Steam and Steam Drop.
Chambersburg Engineering Co.

Hand Tools.
Starrett Co., The L. S.

Hangers
S. K. F. Industries, Inc.

Hangers, Shaft.
Brown & Sharpe Mfg. Co.
Sellers & Co., Inc., Wm.

Headlights, Electric.
General Electric Co.

Heaters
Westinghouse Elec. & Mfg. Co.

Heaters, Oil.
(See Oil Heaters.)

Heating Systems, Car (Electric).
Wine Railway Appliance Co.

High Speed Steel — (See Steel, High Speed).

Hobs.
Brown & Sharpe Mfg. Co.
National Tool Co., The

Hobbing Machines, Gear, Spur and Spiral.
Brown & Sharpe Mfg. Co.

Hoists, Air.
Hanna Engineering Works
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.
Whiting Corporation.

Hoists, Coach.
Whiting Corporation.

Hoists, Electric.
American Engineering Co.
General Electric Co.
General Machinery Corp. of Delaware.
Westinghouse Elec. & Mfg. Co.

Hoists, Hand.
General Machinery Corp. of Delaware.

Hoists, Hydraulic.
Chambersburg Engineering Co.

Hoists, Locomotive.
Whiting Corporation.

Hoists, Portable.
Ingersoll-Rand Co.
Whiting Corporation.

Hoists, Transformer.
Whiting Corporation.

Hooks, Wrecking
National Malleable & Steel Castings Co.

Hose, Air.
Cleveland Pneumatic Tire Co.
Ingersoll-Rand Co.
Westinghouse Air Brake Co.

Hose, Air Brake.
Westinghouse Air Brake Co.

Hose, Clamp Tool.
Ingersoll-Rand Co.

Hose Couplings—(See Couplings, Hose).

Hose, Flexible Metallic.
Barco Mfg. Co.
Franklin Ry. Supply Co.

Hose, Welding
Milburn Co., The Alexander.

Hydraulic Machinery.
Chambersburg Engineering Co.
General Machinery Corp. of Delaware.
Ingersoll-Rand Co.
United Eng. & Fdry. Co.
Watson-Stillman Co., The

Indicators, Speed and Test.
Brown & Sharpe Mfg. Co.

Ingots.
American Rolling Mill Co.
Carnegie Steel Co.

Injectors.
Sellers & Co., Inc., Wm.

Injectors, Live and Exhaust Steam.
Sellers & Co., Inc., Wm.
Superheater Co., The

Injectors, Feedwater Heater Exhaust Steam.
Sellers & Co., Inc., Wm.

Injectors, Live Steam, Locomotive.
Sellers & Co., Inc., Wm.

Instruments, Precision Measuring.
Brown & Sharpe Mfg. Co.

Insulating Materials.
General Electric Co.

Intensifiers, Hydraulic.
Chambersburg Engineering Co.

Iron, Bar.
Highland Iron & Steel Co.
Reading Iron Co.

Iron, Charcoal.
Wrought Iron Research Ass'n.

Iron, Pig.
Bethlehem Steel Co.

Iron, Staybolt.
Bethlehem Steel Co.
Wrought Iron Research Ass'n.

Iron, Wrought.
Highland Iron & Steel Co.
Wrought Iron Research Assn.

Iron Cement.
Smooth-On Mfg. Co.

Jacks, Hydraulic.
Watson-Stillman Co., The

Jigs and Fixtures.
Brown & Sharpe Mfg. Co.
Gidding & Lewis Mach. Tool Co.
Ingersoll Milling Machine Co., The.

Joggling Machines.
Quickwork Co., The

Joints, Air Reservoir
Barco Mfg. Co.
Franklin Ry Supply Co.

Joints, Coach.
Franklin Ry. Supply Co.

Joints, Coach Yard.
Barco Mfg. Co.

Joints, Flexible Ball.
Barco Mfg. Co.
Franklin Ry Supply Co.

Joints, Flexible for Engine Tender Connections.
Barco Mfg. Co.
Franklin Ry. Supply Co.

Joints, Rail.
Carnegie Steel Co.

Joints, Roundhouse Blower Line.
Barco Mfg. Co.

Joints, Steam Liquid, Air.
Barco Mfg. Co.
Franklin Ry. Supply Co.

Joints, Swing.
Barco Mfg. Co.
Franklin Ry. Supply Co.

Journal Boxes and Lids
National Malleable & Steel Castings Co.

Key-Bolts.
Key-Bolt Appliance Co.

Key Bolts, Fitting-Up
McKaig Hatch, Inc.

Key-Way Cutters (Portable and Stationary).
Morton Mfg. Co.

Keys, Brake Shoe.
Bradford Corp., The.

Keys, Finished Machine.
Morton Mfg. Co.

Knuckle Emergency (For Couplers).
Q. & C. Co., The.

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Ladders, Steel Car.
Wine Railway Appliance Co.

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In the Bethlehem Tool Steel Metallurgical Laboratories every possible care is exercised to be sure that all Bethlehem Tool Steel measures up to the standards set for it. The Tool Steel Specialists in these laboratories, with complete equipment for testing and analyses, search out the innermost qualities that affect the performance of the steel. Tool Steel that passes them has proved its right to carry the name "Bethlehem."

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An oil-hardening alloy steel, developed for hand and pneumatic chisels; for punches and shear blades; as well as for set screws and machinery parts.

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Gives remarkable results in heavy-duty tools for lathes, planers, boring mills and other similar machine tools, as well as in twist drills, milling cutters, taps, reamers, gear-cutting hobs, inserted saw teeth, pipe-threading dies, special dies and punches.

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General Electric Co.
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Lathe Attachments, Engine.
McCrosky Tool Corp.

Lathes, Automatic Chucking and Turning.
Bullard Co., The.
Gisholt Machine Co.
Jones & Lamson Machine Co.
Monarch Machine Tool Co. The.

Lathes, Axle.
Betts Works of Consolidated Machine Tool Corp. of America
General Machinery Corp. of Delaware.
Manning, Maxwell & Moore, Inc.
Monarch Machine Tool Co. The.
Sellers & Co., Inc., Wm.

Lathes, Brass.
Consolidated Mach. Tool Corp. of America

Lathes, Car Wheel.
Betts Works of Consolidated Machine Tool Corp. of America.
General Machinery Corp. of Delaware.
Manning, Maxwell & Moore, Inc.
Monarch Machine Tool Co., The.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.

Lathes, Driving Wheel.
Betts Works of Consolidated Machine Tool Corp. of America.
General Machinery Corp. of Delaware.
Manning, Maxwell & Moore, Inc.
Monarch Machine Tool Co., The.
Ryerson & Son, Jos. T.
Sellers & Co., Inc., Wm.

Lathes, Engine.
Betts Works of Consolidated Machine Tool Corp. of America.
Manning, Maxwell & Moore, Inc.
Monarch Machine Tool Co, The.

Lathes, Engine Attachments.
General Machinery Corp. of Delaware
Monarch Machine Tool Co. The.
Ryerson & Son, Jos. T.

Lathes, Extension and Gap.
General Machinery Corp. of Delaware.
Monarch Machine Tool Co., The.
Ryerson & Son., Jos. T.

Lathes, Journal Truing.
Betts Works of Consolidated Machine Tool Corp. of America.
General Machinery Corp. of Delaware.
Manning, Maxwell & Moore, Inc.
Monarch Machine Tool Co., The.

Lathes Turret.
Betts Works of Consolidated Machine Tool Corp of America.
Brown & Sharpe Mfg. Co.
Bullard Co., The.
Jones & Lamson Mach. Co.
Monarch Machine Tool Co., The.

Line Shaft.
SKF Industries, Inc.

Locomotive Exhaust Steam Injectors.
The Superheater Co.

Locomotive — Feed Water Heaters
The Superheater Co.
Worthington Pump & Machinery Co.

Locomotive Frame Drilling Machines.
Gidding & Lewis Mach. Tool Co.
General Machinery Corp. of Delaware.

Locomotive Frame Grinding Machines, Portable Pneumatic.
Buckeye Portable Tool Co.

Locomotive Guide Liners.
Starrett Co., The, L. S.

Locomotive Repair Equipment
Rooksby & Co., E. J.
Underwood Corp., H. B.

Locomotive Throttles
American Throttle Co.

Locomotives.
American Locomotive Co.
Baldwin Locomotive Wks., The
Bethlehem Steel Co.
General Electric Co.
Lima Locomotive Works.
Westinghouse Elect. & Mfg. Co.

Locomotives, Compressed Air.
Baldwin Locomotive Co.

Locomotives, Contractors'
American Locomotive Co.,
Baldwin Locomotive Wks., The.
Lima Locomotive Works.

Locomotives, Electric.
American Locomotive Co. The
Baldwin Locomotive Wks.,
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Locomotives, Mine.
Baldwin Locomotive Wks., The.
General Electric Co.

Locomotives, Oil Engine Elec. Driven.
American Locomotive Co.
General Electric Co.
Ingersoll-Rand Co.

Lubricators.
Franklin Ry. Supply Co.
Hennessy, J. J.
Lunkenheimer Co.
Reliance Machine & Stamping Wks., Inc.
U. S. Graphite Co.

Lubricators, Graphite.
Dixon Crucible Co., Joseph
Lunkenheimer Co.
U. S. Graphite Co.

Lubricators, Journal.
Hennessy, J. J.

Machinery, Flanging.
Chambersburg Engineering Co.

Machinery, Woodworking and Sawing.
Buffalo Force Co.

Machinists' Tools — (See Tools, Machinists').

Mandrels—(See Arbors and Mandrels).

Manifolds, Oxygen
Milburn Co., The Alexander.

Mechanical Draft Equipment.
Buffalo Forge Co.

Metal Cleaner.
Ford Co., The J. B.
Oakite Products, Inc.

Metallic Packing—(See Packing Metallic.)

Micrometer Calipers — (See Calipers, Micrometer).

Millers Frame Jaw
Micro Machine Co.

Milling Attachments.
Ingersoll Milling Machine Co.
Rooksby & Co., E. J.
Underwood Corp., H. B.

Milling Cutters.
Brown & Sharpe Mfg. Co.
Geometric Tool Co., The.
Gidding & Lewis Mach. Tool Co.
Ingersoll Milling Mach. Co.
Modern Tool Works of the Consolidated Mach. Tool Corp. of America.
National Twist Drill Co.
Niles Tool Works Co.

Milling Machines, Automatic.
Brown & Sharpe Mfg. Co.
Ingersoll Milling Mach. Co.

Milling Machine, Car, Journal Brass.
Morton Mfg. Co.

Milling Machines, Continuous Circular
Ingersoll Milling Mach Co.
Newton Machine Tool Works of the Consolidated Machine Tool Corp. of America.

Milling Machines, Hand.
Brown & Sharp Mfg. Co.

Milling Machines, Heavy Duty.
Brown & Sharpe Mfg. Co.

Milling Machines, Horizontal.
Betts Works of Consolidated Mach. Tool Corp. of America.
Gidding & Lewis Mach. Tool Co.
Ingersoll Milling Machine Co., The.
Lucas Machine Tool Co.
Niles-Bement Pond Co.
Sellers & Co., Inc., Wm.

Milling Machines, Horizontal, Plain.
Gidding & Lewis Mach. Tool Co.
Ingersoll Milling Mach. Co.
Lucas Machine Tool Co.
Newton Works of Consolidated Machine Tool Corp. of America
Niles Tool Works Co.

Milling Machines, Horizontal, Universal
Ingersoll Milling Mach. Co.

Milling Machines, Keyseat.
Ingersoll Milling Mach Co.
Newton Works of Consolidated Machine Tool Corp. of America.

Milling Machines, Plain.
Brown & Sharpe Mfg. Co

Milling Machines, Planer Type.
Sellers & Co., Inc., Wm.

Milling Machines, Portable.
Gidding & Lewis Mach. Tool Co.
Newton Works of Consolidated Machine Tool Corp. of America.
Rooksby Co., E. J.
Underwood Corp., H. B.

Milling Machines, Radius.
Ingersoll Milling Mach Co.
Newton Works of Consolidated Machine Tool Corp. of America.

Milling Machines, Slab.
Ingersoll Milling Co.
Newton Works of Consolidated Machine Tool Corp. of America.
Niles Tool Works Co.

Milling Machines, Tread
Newton Works of Consolidated Machine Tool Corp of America.

Milling Machines, Universal.
Brown & Sharpe Mfg. Co.

Milling Machines, Vertical
Betts Works of Consolidated Machine Tool Corp. of America.
Brown & Sharpe Mfg. Co.
Ingersoll Milling Mach Co.
Newton Works of Consolidated Machine Tool Corp of America.
Niles Tool Works Co.

Mining Machinery.
Ingersoll-Rand Co.
Lima Locomotive Works
Lucas Machine Tool Co.

Molding Machines.
Hanna Engineering Works

Monorail Systems.
Whiting Corporation.

Motors Electric
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Multiple Drills—(See Drilling Machines, Multiple Spindle).

Multiple Punches — (See Punching Machines, Multiple).

Nails, Copper Covered
Page Steel & Wire Co.
Reading Iron Co.

Nails, Cut.
Reading Iron Co.

Nipple Threading Machines.
Landis Machine Co.

Nozzles, Exhaust
Franklin Ry. Supply Co.

Nut Burring Machines
National Machinery Co., The.

Nut Driving Machines, Portable Pneumatic.
Buckeye Portable Tool Co.

Nut Facing Machines.
Landis Machine Co.

Nut Couplings.
Sellers & Co., Inc., Wm.

Nut Machines.
National Machinery Co. The.

Nut Steel—Bronze Coupling.
Sellers & Co., Inc., Wm.

Nut Tapper—(See Bolt and Nut Machinery).

Nut Tapping Machines
National Machinery Co.,

Nuts, Castellated.
Sellers & Co., Inc., Wm.

Oil Burning Equipment.
Morton Mfg. Co.

Oil Cups
Lunkenheimer Co., The

Oil Plugs.
Franklin Ry Supply Co.

Oil Pumps.
Lunkenheimer Co.

Oiling Systems
Lunkenheimer Co.

Oxy-Acetylene Welding and Cutting — (See Cutting and Welding Apparatus)

Packing, Air Pump.
Garlock Packing Co., The

Packing, Asbestos.
Garlock Packing Co., The

Packing, Iron.
Smooth-On Mfg. Co.

Packing, Metallic.
Garlock Packing Co.

Packing, Sheet.
Garlock Packing Co., The

Packing Soft
Garlock Packing Co., The

Packing, Valve Stem.
Garlock Packing Co., The

Paint, Graphite.
Dixon Crucible Co., Jos.
U. S. Graphite Co.

Paint Spraying Equipment
De Vilbiss Mfg. Co.
Eclipse Air Brush Co.

Paint Strippers.
Oakite Products, Inc.

Partitions, Woven Steel.
Page Steel & Wire Co.

Pedestal Jaw Facing Machines.
Underwood Corp., H. B.

Piling, Sheet Steel.
Bethlehem Steel Co.
Carnegie Steel Co.

Pilot Beams, Cast Steel.
General Steel Castings Co.

Pilots, Cast Steel.
General Steel Castings Co.

Pins, Coupler Knuckle.
National Malleable & Steel Castings Co.

Pipe Benders, Hydraulic — (See Bending Machines)

Pipe Cutters — (See Cutters, Pipe).

Pipe Cutting and Threading Machinery.
Landis Machine Co., Inc.
Manning, Maxwell & Moore, Inc.

Pipe Fitters' Tools.
Walworth Co.
Williams Tool Corp.

Pipe Fittings.
Dart Mfg. Co., E. M.
Lunkenheimer Co.
Walworth Co.

Pipe Joint Compound.
U. S. Graphite Co.

Pipe, Steel-Signal
National Tube Co.

Pipe Vises—(See Vises, Pipe)

Pipe Unions.
Dart Mfg. Co.
Lunkenheimer Co.
Walworth Manufacturing Co.

Pipe, Welded Steel.
National Tube Co.

Pipe, Wrought Iron.
Reading Iron Co.

Planers,
Betts Works of Consolidated Machine Tool Corp. of America.
General Machinery Corp. of Delaware.
Manning, Maxwell & Moore, Inc.
Sellers & Co., Inc., Wm.

Planers, Crank.
Newton Works of Consolidated Machine Tool Corp. of America.

Planers, Draw Cut Cylinder.
Morton Mfg. Co.

Planers, Low Cylinder.
Morton Mfg. Co.

Planers, Roll Wabble.
Morton Mfg. Co.

Planers, Portable.
Morton Mfg. Co.
Underwood Corp., H. B.

Planers, Plate.
Cleveland Punch & Shear Works Co., The
Hilles & Jones Works of Consolidated Machine Tool Corp. of America.
Sellers & Co., Inc., Wm.

Planers, Rotary.
Cleveland Punch & Shear Works Co., The
General Machinery Corp. of Delaware.
Newton Works of Consolidated Machine Tool Corp. of America.
Underwood Corp., H. B.

Planers, Traveling Head
Morton Mfg. Co.

Planers, Valve Seat.
Rooksby & Co., E. J.
Underwood Corp., H. B.

Planing Attachments, Radius
Underwood Corp., H. B.

Platforms, Car.
General Steel Castings Corp.

Plates.
American Rolling Mill Co.
Bethlehem Steel Co.
Carnegie Steel Co.
International Nickel Co.
National Malleable & Steel Castings Co.

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Carnegie Steel Co.

Plates, Iron and Steel
Bethlehem Steel Co.
Carnegie Steel Co.
Wrought Iron Research Ass'n.

Plates, Monel Steel
International Nickel Co.

Plates, Surface.
Brown & Sharpe Mfg. Co.

Plates, Tie.
Bethlehem Steel Co.
National Malleable & Steel Castings Co.

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General Steel Castings Co.

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Lunkenheimer Co.

Plunger Pumps
Ingersoll-Rand Co.
Worthington Pump & Machinery Co.

Pneumatic Drills—(See Drilling Machines, Portable, Pneumatic).

Pneumatic Flue Welders — (See Flue Welders)

Pneumatic Grinders — (See Grinding Machines, Portable, Pneumatic).

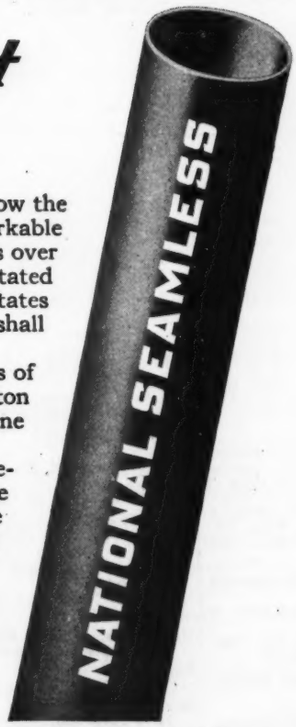
A new world's endurance record

A 7,350 mile run without drawing the fire!

Locomotive No. 4113 of the St. Louis and San Francisco Railroad is now the world's endurance record holder, having recently completed the remarkable run of 7,350 miles in 26 days without having its fire knocked. This is over double the mileage of the former record, and officials of the company stated that the endurance run would have continued except for a United States Department of Commerce regulation providing that all locomotives shall undergo federal inspection and be placed in the shop every 30 days.

During the 26 days of the run the engine consumed 1,171,466 gallons of water, 1,516,425 lbs. of coal and handled a total of 15,509,812 gross ton miles. A thorough inspection on completion of the test showed the engine to be in good condition.

In establishing such a remarkable record as this, efficient crews, dependable fuel and good lubrication were of course essential—yet a large portion of the credit must go to the equipment of the locomotive, more especially the boiler tubes and locomotive piping. Only the highest quality tubes and piping could hold up in such a rigid service test. It was a sound, conclusive proof of the all-around worth of NATIONAL-SHELBY Boiler Tubes and NATIONAL Pipe with which this engine was equipped—the same demonstrated qualities that have made NATIONAL-SHELBY Tubes—



AMERICA'S STANDARD BOILER TUBES

Ask for Bulletin No. 12

NATIONAL TUBE COMPANY

Frick Building, Pittsburgh, Pa.

SUBSIDIARY OF UNITED STATES STEEL CORPORATION

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Pneumatic Loco Turntable Motor — (See Motors, Pneumatic Turntable).

Pneumatic Riveters — (See Hammers, Pneumatic)

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National Tube Co.

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Portable Tools.
Rooksby & Co., E. J.
Underwood Corp., H. B.

Power Reverse Gears — (See Reverse Gears, Power).

Preheating Apparatus
Milburn Co., The Alexander.

Presses, Arbor.
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Watson-Stillman Co., The

Presses, Banding.
Chambersburg Engineering Co.
Watson-Stillman Co., The

Presses, Bending or Straightening.
Chambersburg Engineering Co.

Presses, Bushing.
Chambersburg Engineering Co.
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Watson-Stillman Co., The.
Wood & Co., R. D.

Presses, Crank Pin.
Watson-Stillman Co., The
Wood & Co., R. D.

Presses, Flanging—Hydraulic
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Watson-Stillman Co., The
Wood & Co., R. D.

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United Eng. & Fdry. Co.
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Chambersburg Engineering Co.
General Machinery Corp. of Delaware.
Seller & Co., Inc., Wm.
United Eng. & Fdry. Co.
Watson-Stillman Co., The.

Presses, Wheel.
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General Machinery Corp. of Delaware.
Watson-Stillman Co., The.
Wood & Co., R. D.

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Chambersburg Engineering Co.

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American Engineering Co.
Ingersoll-Rand Co.
Watson-Stillman Co., The.
Wood & Co., R. D.
Worthington Pump & Machinery Co.

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Ingersoll-Rand Co.

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Chambersburg Engineering Co.
Cleveland Punch & Shear Works.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.
Pels & Co., Henry.
Wood & Co., R. D.

Punching Machine, Combined Punch, Shear and Cope.
Buffalo Forge Co.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.
Pels & Co. Henry.

Punching Machine, Horizontal.
Buffalo Forge Co.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.
Pels & Co., Henry.

Punching Machine, Universal, Combined with Plate, Shear, Bar, Angle and Tee Cutter.
Buffalo Forge Co.
Pels & Co., Henry.

Punching Machine, Vertical
Buffalo Forge Co.
Cleveland Punch & Shear Works Co., The.
Pels & Co., Henry.

Punching Machines, Multiple.
Buffalo Forge Co.,
Cleveland Punch & Shear Works Co., The.
Hilles & Jones Works of Consolidated Mach Tool Corp. of America.
Pels & Co., Henry

Pyrometers, Superheated Steam.
Superheater Co., The.

Quartering Machine.
General Machinery Corp. of Delaware.

Radial Buffers.
Franklin Ry. Supply Co.

Rail.
Bethlehem Steel Co.

Rail Benders, Portable.
Q. & C. Co., The

Rail, Guard.
Bethlehem Steel Co.

Rail Saws, Circular (Portable).
Q. & C. Co., The.

Rail Reclaiming Equipment.
Gidding & Lewis Mach. Tool Co.

Railway Supplies
Q. & C. Co., The.

Reamer Holders.
McCrosky Tool Corp.
Landis Machine Co.

Reamers.
Brown & Sharpe Mfg. Co.
McCrosky Tool Co.

Reamers, Expanding.
Davis Boring Tool Co.
McCrosky Tool Co.

Reamers, Solid.
Brubaker & Bros., W. L.

Refrigerators.
Wine Railway Appliance Co.

Regulators (Oxygen and Acetylene)
Milburn Co., The Alexander.

Repair Clamps, Air Hose—(See Clamps, Repair)

Replacers
Q. & C. Co., The.

Reverse Gears, Power
Barco Mfg. Co.
Franklin Ry. Supply Co.

Rivet Cutters.
(See Cutters, Rivet)

Rivet Headers.
National Machinery Co., The.

Rivet Heaters, Electric.
General Electric Co.

Rivet Heaters, Oil
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Morton Mfg. Co.

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Acme Machinery Co., The
Ajax Machinery Co.
National Machinery Co.

Rivet Sets.
Cleveland Punch & Shear Works, Co., The.
Carpenter Steel Co., The,
Ingersoll-Rand Co.

Riveters, Compression.
Hanna Engineering Works.

Riveters, Hydraulic.
Allen Co., John F.
Chambersburg Engineering Co.
Hanna Engineering Works.
Watson-Stillman Co., The.
Wood & Co., R. D.

Riveters, Pinch Bug.
Hanna Engineering Works.

Riveters, Pneumatic — (See Hammers, Pneumatic).

Riveting Hammers.
Independent Pneumatic Tool Co.
Ingersoll Rand Co.

Riveting Machines.
Chambersburg Engineering Co.
Hanna Engineering Co.

Rivets.
Burden Iron Co.

Rod Shears.
National Machinery Co., The.

Rods.
Page Steel & Wire Co.

Rods, Monel Metal Nickel.
International Nickel Co.

Rods, Stainless Steel.
Carpenter Steel Co.

Rods and Wire, Welding—(See Welding Rods).

Rolls, Bending and Straightening.
Buffalo Forge Co.
Cleveland Punch & Shear Works Co., The.
General Machinery Corp. of Delaware.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.

Rolls, Reclaiming.
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Franklin Ry. Supply Co.

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Starrett Co., The L. S.

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Dearborn Chemical Co.
Oakite Products, Inc.

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Ingersoll-Rand Co.

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Buckeye Portable Tool Co.

Saws, Hack.
Starrett Co., The L. S.

Saws, Portable Pneumatic
Ingersoll Rand Co.

Saws, Portable Rail.
Q. & C. Co., The.

Saws, Safety.
Newton Works of Consolidated Machine Tool Corp. of America.

Screw Drivers, Portable Pneumatic.
Buckeye Portable Tool Co.

Screw Machines, Automatic.
Brown & Sharpe Mfg. Co.

Screw Machines, Plain and Hand.
Brown & Sharpe Mfg. Co.
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Screw Machine Tools and Equipment.
Jones & Lamson Machine Co.

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Brubaker & Bros., W. I.

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Brown & Sharpe Mfg. Co.

Screws, Hardened Metallic Drive.
Parker Kalon Corp.

Screws, Hardened, Sheet Metal.
Parker Kalon Corp.

Seaming Machines.
Quickwork Co., The.

Shafting, Steel Tubing.
National Tube Co.

Shapers.
Consolidated Machine Tool Corp. of America.
General Machinery Corp. of Delaware.
Morton Mfg. Co.

Shapers, Draw Cut, Frog and Switch.
Morton Mfg. Co.

Shapers, Draw Cut, Motor Frame.
Morton Mfg. Co.

Shapers, Draw Cut Plow Share.
Morton Mfg. Co.

Shapers, Draw Cut Railroad.
Morton Mfg. Co.

Shapers, Draw Cut Roll Wabble.
Morton Mfg. Co.

Shapes, Structural.
Carnegie Steel Co.

Shearing and Flanging Machines, Combined.
Quickwork Co., The.

Shearing and Joggling Machines, Combined.
Quickwork Co., The.

Shearing Machines, Angle.
Buffalo Forge Co.
Cleveland Punch & Shear Works Co., The.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.
Pels & Co., Henry.

Shearing Machines, Bar Iron.
Chambersburg Engineering Co.
Cleveland Punch & Shear Works Co., The.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.
Pels & Co., Henry.

Shearing Machines, Bevel.
Cleveland Punch & Shear Works Co., The.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.
Quickwork Co., The.

Shearing Machines, Billet.
Pels & Co., Henry.

Shearing Machines, Gate.
Cleveland Punch & Shear Works Co., The.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.
Pels & Co., Henry.

Shearing Machines, Metal-Slitting.
Pels & Co., Henry.
Quickwork Co., The.

Shearing Machines, Plate.
Cleveland Punch & Shear Works Co., The.
Quickwork Co., The.
Pels & Co., Henry.

Shearing Machines, Rotary.
Rotary Bevel, and Rotary Splitting.
Quickwork Co., The

Shears, Beveling.
Quickwork Co., The.

Shears, Beveling Top and Bottom.
Quickwork Co., The.

Shears, Circle.
Quickwork Co., The.

Shears, Circle and Flanging
Quickwork Co., The.

Shears, Plate.
Pels & Co., Henry
Quickwork Co., The.

Shears, Plate, Sheet-Metal, Rotary.
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America.
Quickwork Co., The.

Shears, Rotary, Rotary Circle and Rotary Slitting.
Quickwork Co., The.

Shears, Shearing and Flanging Combined.
Quickwork Co., The.

Shears, Sheet-Metal.
Quickwork Co., The.

Shears, Sheet-Metal Rotary.
Quickwork Co., The.

Sheets, Annealed, Black, Galvanized.
American Rolling Mill Co.

Sheet Metal Machinery.
Quickwork Co., The.

Sheet Steel — (See Steel Sheet.

Sheets, Monel Metal Nickel.
International Nickel Co.

Sheets, Steel.
Bethlehem Steel Co.

Signal Pipe, Wrought Steel
National Tube Co.
Reading Iron Co.

Skid Shoes, Rail
Q. & C. Co., The.

Slag, Blast Furnace.
Carnegie Steel Co.

Slotting Machinery, Frame
Betts Machine Co.
Sellers & Co., Inc., Wm.

Slotting Machines.
Betts Works of Consolidated Machine Tool Corp. of America.
Manning, Maxwell & Moore, Inc.
Newton Works of Consolidated Machine Tool Corp. of America.
Sellers & Co., Inc., Wm.

Small Tools.
Cleveland Punch & Shear Works Co., The.

Snow Melting Device
Q. & C. Co., The.

Snow Plows.
Q. & C. Co., The.

Special Machinery.
Betts Works of Consolidated Machine Tool Corp. of America.
Gidding & Lewis Mach. Tool Co.
Ingersoll Milling Machine Co., The.
Lucas Machine Tool Co.
Newton Works of Consolidated Machine Tool-Corp. of America.
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Whiting Corporation.

Splice Bars, Angle.
Bethlehem Steel Co.
Carnegie Steel Co.

Splitters, Nut
Porter, Inc., H. K.

Spraying Machine, Paint — (See Paint Spraying Equipment).

Spring Banding Presses, Hydraulic — (See Presses, Banding).

Spring Plates and Seats
National Malleable & Steel Castings Co.

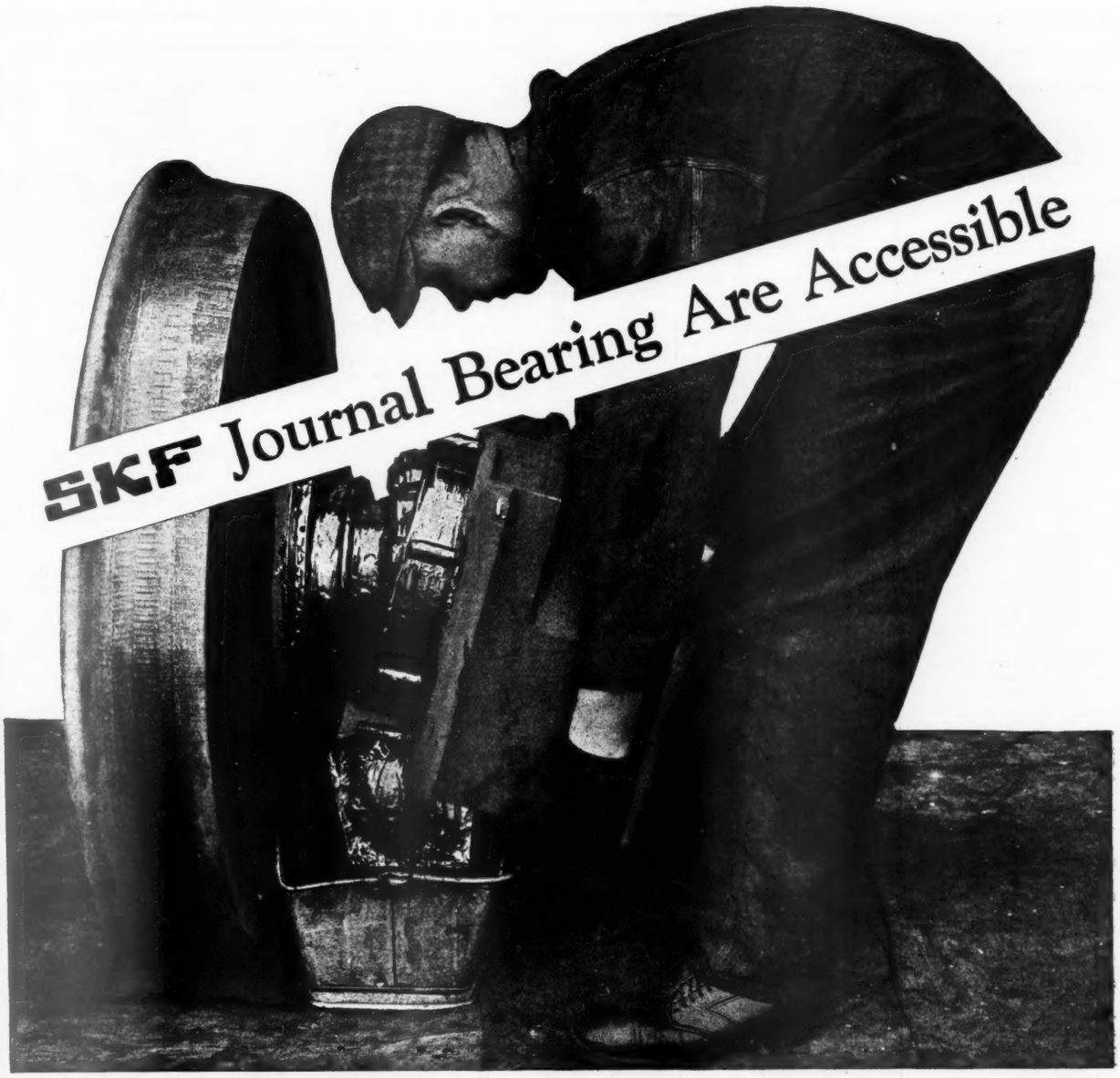
Spring Shop Machinery.
Wood & Co., R. D.

Springs, Car & Engine.
American Steel Foundries.

Squares, Combination.
Brown & Sharpe Mfg. Co.

Squeezers, Rivet
Porter, Inc., H. K.

Staybolt and Bolt Turning Threading Machines.
Consolidated Machine Tool Corp. of America



You Can Keep An Eye On Them Even If They Need No Maintenance

THE railroad man who plays safe feels the need of occasional inspection of his roller bearings, if only for peace of mind.

SKF Journal Bearings are readily accessible.

No long, complicated shop job is necessary for a complete examination of rollers and races.

Remove a few bolts and take off the journal box—by hand.

There the whole bearing lies exposed to view. It need not be stripped to its various elements to permit a detailed inspection of every part of the bearing. When on the road SKF Journal Bearings run without attention. When in the shop for class repairs, attention is made easy, time and money is saved.

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Staybolt Taps.
Flannery Bolt Co.

Staybolt Testers, Flexible (Elect. Contact).
Flannery Bolt Co.

Staybolts
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National Tube Co.

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Franklin Ry. Supply Co.

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Steam Hammers—(See Hammers, Steam Forging).

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Carnegie Steel Co.
Carpenter Steel Co., The.
Central Alloy Steel Co., The
S. K. F. Industries.
Timken Roller Bearing Co.

Steel, Carbon.
Carnegie Steel Co.
S. K. F. Industries.
Timken Roller Bearing Co.

Steel, Die.
S. K. F. Industries.
Timken Roller Bearing Co.

Steel Firebox
Bethlehem Steel Co.
Carnegie Steel Co.

Steel, Heat Treated.
Carpenter Steel Co., The.
Bethlehem Steel Co.

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Timken Roller Bearing Co.

Steel, Stainless.
Carpenter Steel Co., The.

Steel, Structural.
Bethlehem Steel Co.
Carnegie Steel Co.

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Steel, Tool.
S. K. F. Industries.

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American Engineering Co.

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Superheater Co., The

Superheater Pipes.
National Tube Co.

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Superheater Co., The.

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Syphons, Locomotive
Locomotive Firebox Co.

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Whiting Corporation.

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Geometric Tool Co., The.
National Machinery Co.

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Landis Machine Co., Inc.

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Geometric Tool Co., The
Landis Machine Co.
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Sellers & Co., Inc., Wm.

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Testing Machines, Gear Tooth
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Testing Machines, Drop—(See Drop Testing Machines).

Thread Cutting Machines, Bolt
Acme Machinery Co., The

Thread Cutting Machine, Pipe
Landis Machine Co., Inc.
Williams Tool Corp.

Thread Millers—(See Milling Machines, Thread).

Threading Machines, Automatic.
Brown & Sharpe Mfg. Co.

Threading Machine, Bolt and Stud.
Buffalo Forge Co.
Cleveland Automatic Machine Co., The.
Geometric Tool Co., The
Landis Machine Co., Inc.
Williams Tool Corp.

Threading Tools—(See Tools, Threading).

Throttles, Locomotive.
American Throttle Co.

Tie Wires.
Page Steel & Wire Co.

Ties, Steel.
Carnegie Steel Co.

Tire Turning and Boring Mills—(See Boring Machines, Tire)

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Carpenter Steel Co., The.
Ingersoll-Rand Co.

Tools, Boring, Expansion.
Davis Boring Tool Co.

Tools, Boring Mill.
O. K. Tool Co.

Tools High Speed Steel
Bird-Archer Co., The.

Tools, Inspection.
Brown & Sharpe Mfg. Co.

Tools, Machinists'
Brown & Sharpe Mfg. Co.
Starrett Co., The L. S.

Tools, Lathe.
O. K. Tool Co.

Tools, Planing.
O. K. Tool Co.

Tools, Shaper.
O. K. Tool Co.

Tools, Shop.
O. K. Tool Co.

Tools, Threading (See also Dies, Threading, Self Opening).
Cleveland Automatic Machine Co. The.
Landis Machine Co. Inc.

Torches,
Morton Mfg. Co.

Torches, Welding—(See Cutting and Welding Apparatus).

Tractors, Industrial Electric
Baker-Raulang Co.

Transmission
SKF Industries, Inc.

Transmission, Silent Chain—(See Chain Drive).

Traverse Shapers—(See Shapers, Traveling Heaters.

Trolley Systems.
Whiting Corporation.

Trolleys, I-Beam.
Hanna Engineering Works.

Truck Bolsters—(See Bolsters Car).

Trucks, Car and Locomotive
American Steel Foundries.
General Steel Castings Corp.
Franklin Ry. Supply Co.

Trucks, Electric.
American Locomotive Co.
Baldwin Locomotive Wks., The.
Chisholm-Moore Mfg. Co.

Trucks, Electric Storage Battery.
Baker-Rauling Co.

Trucks, Frame, Cast Steel.
American Steel Foundries.
General Steel Castings Corp.

Trucks, Industrial Electric.
Baker-Raulang Co.
Whiting Corporation.

Trucks, Trailer.
Franklin Ry. Supply Co.

Trucks, Welding
Milburn Co., The Alexander.

Tube Cleaners.
Roto Co., The.

Tube Cutters—(See Cutters, Flue)

Tube Expanders — (See Flue Expanders).

Tubes, Boiler.
Bethlehem Steel Co.
National Tube Co.

Tubes, Charcoal Iron.
Bethlehem Steel Co.

Tubes, Nickel
International Nickel Co.

Tubing, Lap, Welded and Seamless Steel.
National Tube Co.
S. K. F. Industries.
Timken Roller Bearings Co.

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Worthington Pump & Machinery Corp.

Turbines, Steam.
Buffalo Forge Co.

Turbo-Generators.
General Electric Co.

Turntables, Industrial Railway.
Whiting Corporation.

Turret Forming Machines, Automatic.
Brown & Sharpe Mfg. Co.

Turret Lathes—(See Lathes, Turret).

Twist Drills — (See Drills, Twist.)

Underframes, Tender, Cast Steel.
General Steel Castings Co.

Unions, Pipe.
Dart Mfg. Co., E. M.
Lunkenheimer Co.
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Universal Grinding Machines (See Grinding Machines Universal).

Upsetting Machines — (See Forging Machines).

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Chambersburg Engineering Co.
Watson-Stillman Co., The.

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Garlock Packing Co., The

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Lunkenheimer Co.
Walworth Manufacturing Co.

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Lunkenheimer Co.

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Valves Hydraulic.
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Watson-Stillman Co., The

Valves, Injector Check and Angle Steam.
Sellers & Co., Inc., Wm.

Valves, Piston.
Franklin Ry. Supply Co.

Valves, Pop, Safety and Relief.
Ashton Valve Co.
Lunkenheimer Co.
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Valves, Rubber Pump.
Garlock Packing Co., The

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Bradford Corp., The.
Lunkenheimer Co.

Valves, Water.
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Buffalo Forge Co.

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Wine Railway Appliance Co.

Vibrators, Pneumatic.
Hanna Engineering Works

Vises, Milling Machine.
Brown & Sharpe Mfg. Co.

Vises, Pipe.
Walworth Co.

Washer Cutting Machine
National Machinery Co., The

Washer Machines
National Machinery Co., The

Washers.
National Malleable & Steel Castings Co.

Washers, Lock
National Malleable & Steel Castings Co.

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Welding and Cutting Apparatus—(See Cutting and Welding Apparatus).

Welding Machines, Electric.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

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Milburn Co., The Alexander.
Oxweld Railroad Service.

Welding Rods and Wire.
Milburn Co., The Alexander.
Page Steel & Wire Co.
Oxweld Railroad Service Co., The.

Wheel Centers, Driving
American Steel Foundries.
General Steel Castings Corp.

Wheel Presses, Hydraulic—(See Presses, Wheel).

Wheels, Buffing
Hunt & Son, C. B.

Wheels, Car and Locomotive
American Steel Foundries
Bethlehem Steel Co.
Carnegie Steel Co.
Lima Locomotive Works.

Wheels, Grinding — (See Grinding Wheels).

Wheels, Mine Car.
Carnegie Steel Co.

Wheels, Steel.
Carnegie Steel Co.

Whistles, Locomotive
Ashton Valve Co.
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Quickwork Co., The

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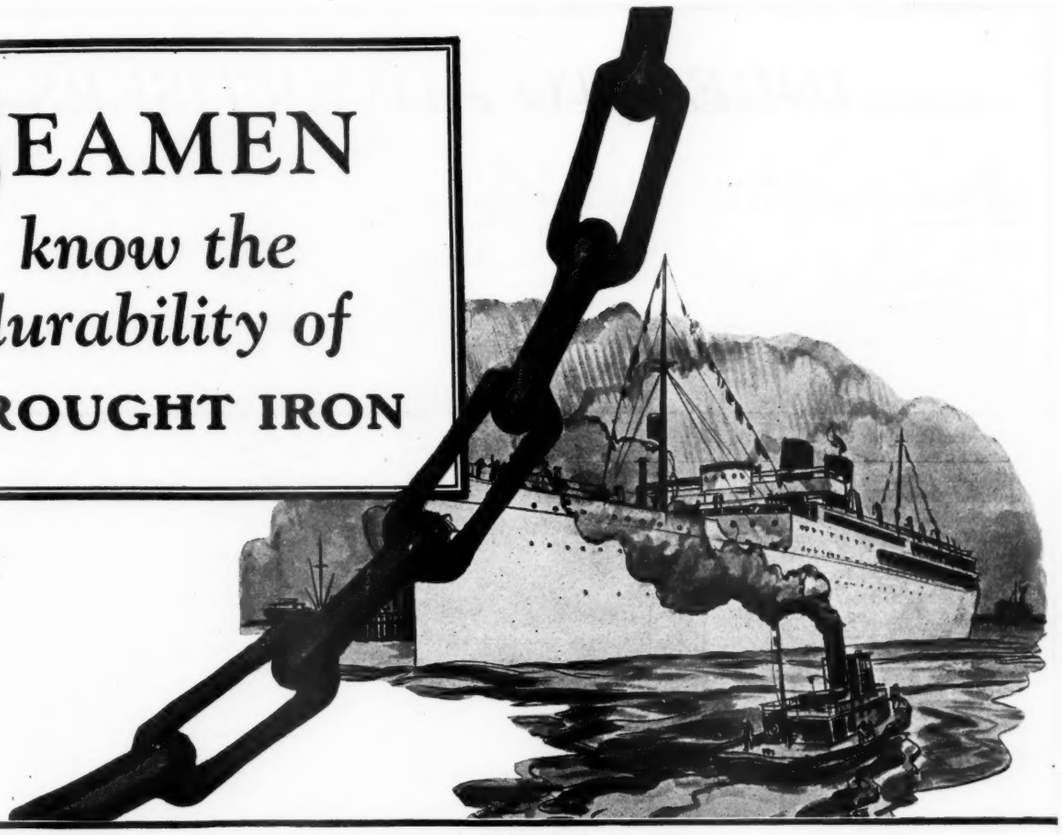

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INDEX TO ADVERTISERS

A

Acme Machinery Co., The 4
Ajax Manufacturing Co., The 15
Allen Co., John F 46
American Locomotive Co. 56, 57
American Rolling Mill Co. 69
American Tel. & Tel. Co. 23
Ashton Valve Co., The 46

B

Baker-Raulang Co., The 19
Baldwin Locomotive Works, The 55
Barco Manufacturing Co. 54
Benjamin Electric Co. 27
Bethlehem Steel Co. 85
Betts Works & Consolidated Mach. Tool Corp. of America 25
Bradford Corporation 72
Brown & Sharpe Mfg. Co. 3
Brubaker & Bros. Co., W. L. 29
Buckeye Portable Tool Co. 31
Buffalo Forge Co. 13
Bullard Co., The 16
Burden Iron Co., The 73
Buyers' Index 80, 82, 84, 86, 88, 90

C

Cardwell Westinghouse Co. 64
Carnegie Steel Co. 71
Central Alloy Steel Corp. 51
Chambersburg Engineering Co. 22
Chicago Railway Equipment Co. 68
Cleveland Pneumatic Tool Co., The 33
Cleveland Punch & Shear Works Co., The 45
Consolidated Mach. Tool Corp. of America 25

D

Dart Mfg. Co., E. M. 79
Davis Brake Beam Co. 75
Dearborn Chemical Co. 81
DeVilbiss Mfg. Co., The 83
Dixon Crucible Co., Joseph 77

E

Eclipse Air Brush Co. 43

F

Flannery Bolt Co. 78
Ford Co., The J. B. 76
Franklin Railway Supply Co., Inc. 53

G

Garlock Packing Co., The 43
General Electric Co. 32
General Machinery Corp. of Delaware 6
General Steel Castings Corp. (Commonwealth Division) 77
Geometric Tool Co., The 45
Giddings & Lewis Machine Tool Co. 7

H

Hanna Engineering Works 44
Heald Machine Co., The 39
Hennessy, J. J. 47
Hilles & Jones Works of Consolidated Mach. Tool Corp. of America 25
Hutto Engineering Co., Inc. 94

I

Ingersoll Milling Machine Co., The 2
Ingersoll-Rand Co. 35
International Nickel Co., Inc., The 65, 70

J

Jenkins Bros. 34
Jones & Lamson Machine Co. 5

K

Key-Bolt Appliance Co. 44

L

Landis Machine Co., Inc. 9
Landis Tool Co. 21
Lima Locomotive Works 52
Locomotive Firebox Co. 58
Lucas Machine Tool Co. 48
Lunkenheimer Co., The 30

M

Manning, Maxwell & Moore, Inc. 14
McKaig-Hatch, Inc. 46
Micro Machine Co. 45
Modern Tool Works of Consolidated Mach. Tool Corp. of America 25
Monarch Machine Tool Co., The 10
Morton Manufacturing Co. 18

N

National Machinery Co., The 22
National Malleable & Steel Castings Co. 59, 60
National Tube Co. 87
Newton Works of Consolidated Mach. Tool Corp. of America 25
Niles Tool Works Co., The 6

O

O. K. Tool Co., Inc. 26
Oakite Products, Inc. 74
Ownership, Statement of 42
Oxweld Railroad Service Co., The 28

P

Page Steel & Wire Co. 46
Parker-Kalon Corp. 37, 41
Pels & Co., Henry, Inc. 24

Q

Quickwork Co., The 44

R

Reading Iron Co. 38
Reliance Machine & Stamping Works 66
Rooksby & Co., E. J. 40
Roto Co., The 47

S

Sellers & Co., Inc., Wm. 17
S. K. F. Industries, Inc. 89
Smooth-On Mfg. Co. 41
Standard Electrical Tool Co. 47
Starrett Co., The L. S. 42
Sullivan Machinery Co. 39
Superheater Co., The 79

T

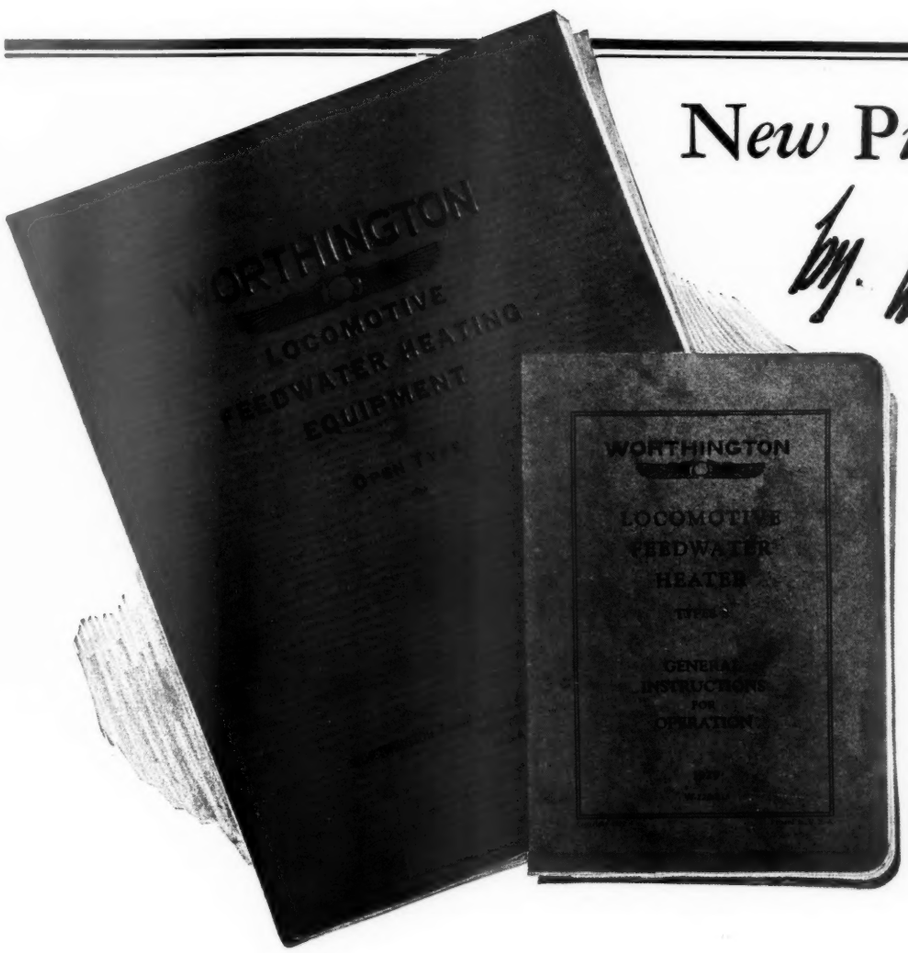
Thompson Grinder Co., The 45
Timken Roller Bearing Co., The 50

U

Underwood Corp., H. B. 8
United Engineering & Foundry Co. 12
United States Graphite Co., The 78

W

Walworth Company 36
Watson-Stillman Co., The 11
Westinghouse Air Brake Co. 61
Westinghouse Friction Draft Gear Co. 61
Whiting Corporation 62, 63
Williams Tool Corp. 40
Wine Railway Appliance Co., The 67
Wood & Co., R. D. 20
Worthington Pump & Machinery Corp. 93
Wrought Iron Research Assoc. 91



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